

**SURVIVAL AND RETIREMENT
EXPERIENCE WITH
WATER WORKS FACILITIES**

SURVIVAL AND RETIREMENT EXPERIENCE WITH WATER WORKS FACILITIES

A Committee Report



AMERICAN WATER WORKS ASSOCIATION

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Introduction

THE water works was the first of the public utilities. In the present communal development of society it may be termed the most essential of all utilities and vital to the health, welfare and convenience of those it serves. The facilities used in developing and supplying water service, although predominantly of a more permanent character than those of other public utilities, are nevertheless subject to mortality and replacement. The very fact that their period of usefulness is so long results in greater difficulty in securing factual data relating to actual life and mortality experience.

The importance of having available factual data relating to retirements of water works property and the causes of retirement is apparent when it is realized that the investment in such facilities on the North American continent exceeds \$5,000,000,000. The financial program of distributing the cost of property consumed in public service over its useful life can only be equitable when based upon a factual background.

Realizing the importance of developing the facts which the water industry must know in this respect, the Board of Directors of the American Water Works Association, in January 1941, authorized the creation of a special committee to undertake the collection

of factual information which would indicate the actual life of water works facilities. An important stimulus to the Committee, at the time of its inception, was the work of the National Association of Railroad and Utilities Commissioners. This national body of representatives from the various utility regulatory commissions of the national and state governments was, at that time, through a special depreciation committee, preparing a treatise on depreciation. The special committee invited the several branches of the utility field to submit factual data developed from past experience which would represent the actual length of life of utility property in past service.

Committee Organization

The Committee on Survival and Retirement Experience With Water Works Facilities authorized by the Board of Directors in January 1941 consisted initially of only the Executive Committee, but this was expanded to a membership of approximately 25 after a preliminary survey indicated that there was a keen interest in the subject throughout the membership of the Association. Acceptance of membership carried with it the implied obligation of assembling such data as were available in the systems represented by the members. Subsequently, late in 1941,

the New England Water Works Association voted to join in the study and appointed a committee to co-operate. Since commencing its work, the Committee has also had the active co-operation of the Institute of Water Supply Utilities, an organization consisting of many of privately-owned water utilities in the country.

A Supervising Co-ordinator was employed by the Committee to correlate the efforts in the various co-operating cities and to assemble, compile and prepare for publication the information received.

The personnel forming the Committee and allied collaborators is set forth on page v.

Object

The Committee's object was to collect and present in readily available and useful form statistics regarding the length of life of the principal elements of water works systems which have been retired and the age of facilities which were still in service. Not only is it important to know how many years of service have been rendered by property items which have been replaced or abandoned but, to be complete, such a study must include the determination of the number of years for which elements of plants still in service have survived. The study was planned to include also a record of the conditions which have caused retirements and a determination of the amount of salvage which may have been realized.

Purpose

The results of a study such as the Committee undertook have a variety of uses. In addition to making possible the equitable amortization of the cost

of an item of property over the period of useful service through the use of mortality studies, such studies carried out in each plant would indicate an element of depreciation affecting the value of plant and property for rate, tax or sale purposes. An accurate knowledge of property life results in a more intelligent forecast of required replacements and indicates the desirable length of bond issues, the economic balance of competing materials or equipment and the advisability of increased maintenance or replacement.

Scope of Study

The study has included, generally, the collection of records relating to the chief facilities used in water plants which reveal the number and length of life of such items of property as have been used and retired, the number and age of those still in service and the distribution by ages throughout the life span.

It was the Committee's aim to select for study cities affording a variety of sizes and types of plants in various sections of the United States and Canada. The cities studied exemplified rapid, slow and normal growth. They were also selected for geographical distribution, ranging from Winnipeg and Ottawa in Canada to West Palm Beach, Fla., and San Francisco, Calif. The systems studied include hard and soft water supplies from both underground and surface sources. The population range of the cities was from 2,400 to 2,000,000.

The number of facilities was divided between publicly- and privately-owned plants, so far as possible in the same proportions as are the entire water works facilities on this continent. Every effort was made to make the

study comprehensive and well balanced.

Individual reports on the following cities have been published in the *Journal of the American Water Works Association*:

<i>City</i>	<i>Volume</i>	<i>Number</i>	<i>Page</i>
Ottawa, Ontario	37	7	654
Des Moines, Iowa	37	7	675
St. Marys, Pennsylvania	37	8	765
Denver, Colorado	37	8	777
Utica, New York	37	9	874
Clinton, Iowa	37	9	897
Alexandria, Virginia	37	10	1054
Winnipeg, Manitoba	37	10	1069
Clyde, New York	37	11	1216
Huntington, West Virginia	37	11	1225
Babylon, New York	37	11	1239
Merrick, New York	37	11	1249
Norwich, New York	37	12	1344
Sag Harbor, New York	37	12	1355
Rochester (Suburban), New York	37	12	1361
Syracuse (Suburban), New York	37	12	1374
Summit, New Jersey	38	1	131
Jamaica, New York	38	2	247
Portland, Maine	38	2	255
Philadelphia, Pennsylvania	38	2	277
St. Paul, Minnesota	38	3	401
Scranton, Pennsylvania	38	3	422
West Palm Beach, Florida	38	4	562
San Francisco, California	38	5	647
Springfield, Massachusetts	38	5	662

A report on Detroit, Michigan, included herewith, was received too late for inclusion in the *Journal*.

Classification of Facilities

Water works facilities lend themselves generally to division into two groups, one consisting of items of like kind occurring in large numbers in all plants, and the other consisting of those relatively few individual units in a system which vary in type, size and length of useful life according to the particular conditions under which they operate.

For the purpose of the Committee's work, these facilities were classified as follows:

<i>Class A Facilities</i>	<i>Class B Facilities</i>
Mains	Impounding Reservoirs
Valves	Tunnels and Aqueducts
Meters	Wells and Infiltration Galleries
Services	Purification Plants
Hydrants	Pumping Equipment
	Distribution Reservoirs
	Elevated Tanks and Standpipes

Record Forms

In order to secure the results desired in comparable form, there were provided for those companies which desired to use them two basic record forms for compiling the information of Class A facilities.

The first consisted of cards upon one side of which was recorded the installation of similar items by years and, upon the reverse, the amounts and dates of retirement of those items on the face of the card which were retired. Such cards were provided for mains, valves, services, meters and hydrants. These are illustrated on page 6.

The second basic record forms were tabular forms properly identified by title for each class of property upon which were summarized the years of installation, amount installed, amount retired and the amount still in service, with spaces for entering retirements in the years in which retired. These forms are reproduced on page 7.

Class B facilities, generally being installed and retired as individual units, required individual summary sheets for each type of facility to record the general descriptions, sizes and other pertinent data properly to identify the structure—its type, size, material of construction, and, when retired, the reasons dictating the retirements. Forms

used for these facilities are shown on pages 8 and 9.

Summarizing of Data

The Supervising Co-ordinator visited a number of cities not included in the study although their records were adequate for mortality studies. Due to wartime shortages in personnel, studies in a few cities, such as Cincinnati, Ohio, Richmond, Va., and Charleston, S.C., where long-time records were available, could not be carried forward. With a few exceptions, the Supervising Co-ordinator visited one or more times the cities collecting and reporting the basic data. He inspected the local records and instructed the plant personnel in collecting, compiling and summarizing the information desired. In the few cities not visited for the particular purpose of the Committee's work, the Co-ordinator had general knowledge of the systems and their records.

The summaries of the records compiled in each city were forwarded to the office of the Supervising Co-ordinator, where they were rearranged in a form convenient for the computation of the mortalities of the particular item of property studied. These mortality computation sheets were of the form shown in insert, facing page 8.

The mortality studies of units of water works property made by the Committee were based on the collection and compilation of the records of all units which were in service during some part of the entire history of the property, as of the date of the study.

Definitions

Definitions of certain terms which were used in the study are as follows:

Service Life—The service life of a physical unit of property is the period

of time between the date when it was placed in service new, as a part of the property, and the date when it was retired from service.

Service Age—The service age of a physical unit of property is the period of time between the date when it was first placed in service new, as a part of the property, and the date of the study or estimation.

Age-Group—An age-group of like physical-property units is a group all of whose present units were put into service during the same year.

Probable Life—The probable life of a physical unit of property is the period of time between the date when it was first placed in service new, as a part of the property, and the future date when, it is estimated, it will be retired from service.

Life Expectancy—The life expectancy of a physical unit of property is the period of time between the date of the study or estimation and the future date when, it is estimated, it will be retired from service.

Average Life—The average life of an age-group or several age-groups of like physical units of industrial units of property is the average number of years of service rendered by the individual units of the group or groups.

Mortality Survival Ratio—The mortality survival ratio is the proportion, in percentage, of survivors of the original members of large numbers of age-groups of like units from year to year, during the service life of the longest surviving member.

Mortality Survival Curves—Mortality survival curves show in graphic form the percentages of survivors of the original members of age-groups of like units from year to year during the service life of the longest surviving member.

In computing mortality survival ratios physical property units were considered placed in service in the middle of a calendar year. Retirements of such units were considered made at the end of calendar years. If a unit was installed and retired in the first year of its life it was considered to have had a service life of 0.5 year; if it was retired in the second year it was considered to have had a service life of 1.5 years, and so on.

On most of the mortality survival curves, a point indicated by a small triangle, represents the age in the mortality record at which the exposures are reduced to less than 10 per cent of the original exposures. The selection of 10 per cent as an indicator was arbitrary. The significance of some such selection is that, in the older portions of the mortality data, the exposures become so small that a minor retirement produces great effect upon the shape of the curve. If the retirement of the oldest unit of property takes place in the year of the study, then the mortality survival ratio becomes zero. Survival in subsequent years tends to eliminate such large variations; consequently, the end portion of all mortality curves will be substantially affected as the age of the property increases.

Summaries

Summaries of the Class A facilities studied by cities and by sizes and

classes are shown on pages 511 to 566, inclusive.

Acknowledgments

The collection and compilation of data in each city were done by the personnel of the local water utilities in all cities except Springfield, Mass., Utica, N.Y., and Philadelphia, Pa., where they were compiled by or under the direction of the Supervising Co-ordinator. The preparation and computation of the mortality survival ratios and curves were carried out in the office of the Supervising Co-ordinator.

The co-operation of the individual members of the Committee in those cities where the study was actively carried forward was excellent. It is impossible accurately to estimate the number of man-hours which entered into the searching of the records and the compilation of results, but they have been exceedingly large. Without the generous donation of this labor by the co-operating members of the Association and their staffs, this report could not have been possible.

The work of the Committee was strictly factual, presenting data on survivals and retirements, together with such explanatory notes regarding retirements as will assist in their interpretation. The Committee does not offer conclusions but does present a vast amount of basic data not previously available.

Executive Committee—LOUIS R. HOWSON, *Chairman*

L. G. LENHARDT

DALE L. MAFFITT

REEVES NEWSOM

THOMAS H. WIGGIN

Supervising Co-ordinator—E. H. ALDRICH

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CITY OR COMPANY

DATE - - -

SUBJECT

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Alexandria, Virginia

As of December 31, 1940

THE privately-owned Alexandria Water Company serves the city of Alexandria, Va., and adjacent territory. The 1940 population of the city was 33,523.

Alexandria is located on the Potomac River in the northern part of the state, about 7 mi. south of Washington, D.C. It was first incorporated in 1749. In 1850 it had a population of 8,754 and grew very slowly until the late twenties, when, because of improved transportation facilities, it benefited greatly from the population overflow from Washington. As a result the population has more than doubled in the last fifteen years and it is continuing to grow rapidly.

The territory served is predominantly residential but there are a few scattered industries. The Potomac Yards, one of the largest freight classification yards in the country, is located at the city's northern limits.

As of Dec. 31, 1940, the date of this study, there were 8,181 consumers, about 55 per cent of whom were served through meter measurement. There were 87 mi. of mains. The average pumpage in 1940 was 3.23 mgd., equivalent to 81 gpd. per capita. About 5 per cent of the water served was for industrial use. Not included in the above is the sale of untreated water to the Southern Railway which amounted to 118 mil.gal.

Development of Existing System

The Alexandria Water Company was incorporated in 1851 and the plant was built in 1851-1852 and put in service in June 1852. The construction was done under the direction of an engineer who had previously built the water works at Harrisburg, Pa., and Fredericktown, Md.

The company was financed by local capital and continued to operate under local ownership and management until 1929 when the capital stock was acquired by the American Water Works and Electric Company, Inc., under whose ownership and management it continues in operation.

The original works consisted of a pumping station at which water was pumped to a 2.5-mil.gal. storage basin from which it was delivered by gravity to consumers through 7 mi. of cast-iron pipe.

The source of supply was Cameron Run. Water from this source was diverted from the stream by a diversion dam below the junction of its tributaries, Holmes Run and Back Lick Run. There were no impounding facilities on the watershed, the natural flow of the streams being sufficient for the requirements at that time. From the diversion dam a race some 9,000 ft. long conveyed the water to the pumping station. The race delivered water

TABLE 1
SUMMARY OF WATER MAINS—ALEXANDRIA, VIRGINIA

Size, <i>in.</i>	Kind	No. of Feet Identified*	Percent- age of Total	No. of Feet Retired	Percent- age of Total	No. of Feet in Service	Percent- age of Total	Year of First Install- ation	Average Age, <i>yr.</i>
4	Cast-iron unlined	97,978	21.6	1,425	6.9	96,553	22.3	1852	48.2
6		125,650	27.7	1,658	8.1	123,992	28.5	1852	28.8
8		30,169	6.6	528	2.6	29,641	6.8	1852	32.8
10		23,404	5.1	42	0.2	23,362	5.4	1852	32.5
12		22,017	4.8	42	0.2	21,975	5.1	1885	25.8
16		3,329	0.7	0	0.0	3,329	0.7	1885	46.7
20		4,246	0.9	0	0.0	4,246	1.0	1885	51.1
2	Cast-iron cement-lined	27,392	6.0	3,032	14.7	24,360	5.6	1930	6.3
6		63,096	13.9	0	0.0	63,096	14.5	1930	3.7
8		18,693	4.1	0	0.0	18,693	4.3	1930	3.1
12		2,061	0.5	0	0.0	2,061	0.5	1931	2.8
$\frac{3}{4}$		349	0.1	0	0.0	349	0.1	1923	16.8
1		266	0.1	0	0.0	266	0.1	1924	16.5
$1\frac{1}{4}$		1,280	0.3	473	2.3	807	0.2	1923	16.7
2	Galvanized steel	12,248	2.7	1,363	6.6	10,885	2.5	1918	15.8
$2\frac{1}{4}$		1,373	0.3	258	1.3	1,115	0.3	1921	14.5
3		1,649	0.4	0	0.0	1,649	0.4	1924	14.2
4		4,249	0.9	2,676	13.0	1,573	0.4	1913	16.5
$1\frac{1}{2}$	Galvanized wrought-iron	3,131	0.7	1,850	9.0	1,281	0.3	1852	15.9
2		9,366	2.1	6,613	32.2	2,753	0.6	1852	15.5
$2\frac{1}{2}$		600	0.1	600	2.9	0	0.0	1866	
3		1,643	0.4	0	0.0	1,643	0.4	1925	15.5
1		Lead	16	0.0	0	0.0	16	0.0	1923
$1\frac{1}{2}$	Lead	18	0.0	0	0.0	18	0.0	1926	14.5
TOTAL		454,223	100.0	20,560	100.0	433,663	100.0		27.0
Percentage of Total		100.00		4.53		95.47			
Average size, <i>in.</i>		5.97		2.87		6.12			

Mortality Survival Ratios

Size, <i>in.</i>	Kind	No. of Feet	Period Covered, <i>yr.</i>	Percentage
$\frac{3}{4}$ – $1\frac{1}{2}$	All	5,060	40.5	0
2–4	Galvanized wrought-iron and galvanized steel	31,128	31.5	0
4	Cast-iron unlined	97,978	88.5	97.991
6		125,650	88.5	88.818
8		30,169	88.5	95.324
10–12		45,421	88.5	99.068
Over 12		7,575	55.5	100.000
2	Cast-iron cement-lined	27,392	10.5	82.734
6–12	Cast-iron cement-lined	83,850	10.5	100.000
TOTAL		454,223		

* Unidentified Pipe: 74 ft. of 4-in. cast-iron unlined; 201 ft. of 6-in. cast-iron unlined.

in sufficient quantity and head to furnish not only the water supply but to provide power to drive an overshot water wheel. A 1-mgd. reciprocating pump, actuated by the water wheel, elevated the water to the storage basin from which it flowed by gravity to the distribution system.

The original pumping station building, which was constructed of limestone, and the raceway were originally part of a mill property constructed many years before. The race still continues in service and the major part of the original building is incorporated in the existing pumping station.

In 1855 a steam engine and boiler were installed in the pumping station, affording an alternate source of power for pumping. The original pump has also continued in service until the present time.

In 1874 and 1875 a second storage basin, with a capacity of about 13.5 mil.gal., was built adjacent to the original basin. These basins are located on a hill about 1 mi. west of the center of Old Alexandria at an elevation of about 100 ft.

The supply as it existed in 1875 sufficed until 1913 when increased demands for water necessitated the construction of an impounding dam on the upper waters of Holmes Run. This dam, known as the Barcroft Dam, is

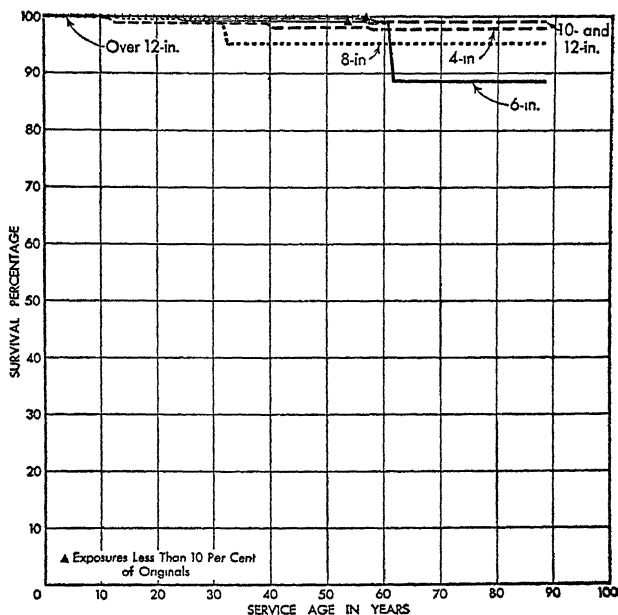


FIG. 1. Mortality Survival Curve—4-20-in. Cast-Iron Unlined Mains—Alexandria, Virginia

BASE: Feet	SURVIVAL: 1852-1940	
SIZE	EXPOSURES	RETIREMENTS
in.	ft.	ft.
4	97,978	1,425
6	125,650	1,658
8	30,169	528
10 and 12	45,421	84
Over 12	7,575	0

a stone and concrete masonry dam, 500 ft. long, with a spillway section 160 ft. long. It is of gravity type construction with a spillway elevation of 205 ft. and a capacity of 600 mil.gal.

The total area of the watershed above the dam is about 14 sq.mi. and the combined area of the sheds on Holmes Run and Back Lick Run above the point of diversion is 33 sq.mi. As presently developed they have an estimated total safe yield of about 7 mgd. The impounded storage is released through control gates into Holmes Run as required. The manner in which the

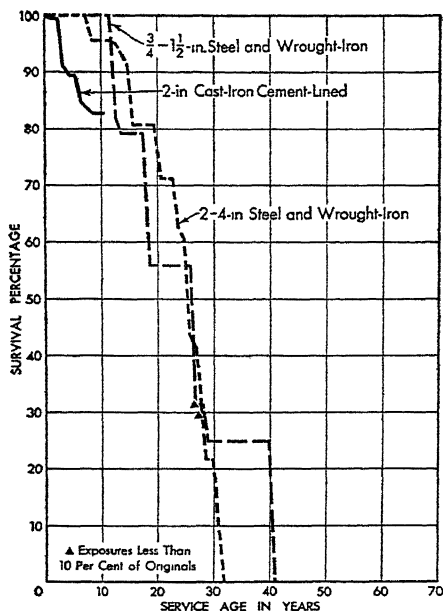


FIG. 2. Mortality Survival Curve— $\frac{3}{4}$ -4-in. Mains—Alexandria, Virginia

BASE: Feet		SURVIVAL: 1852-1940	
SIZE	KIND	EXPOSURES ft	RETIREMENTS ft.
$\frac{3}{4}$ -1 $\frac{1}{2}$	Wrought-Iron and Steel	5,060	2,323
2-4	Wrought-Iron and Steel	31,128	11,510
2	Cast-Iron Cement Lined	27,392	3,032

water is brought to the pump station from the diversion dam through the race is the same now as it was in 1852.

In 1918 a 2.5-mgd. filtration plant was built. It went into service in 1919. It is located adjacent to the storage basins and the original construction consisted of two cypress sedimentation tanks and five New York Continental rapid sand filters.

The elevation of the storage basins was planned to supply the original town of Alexandria, which has an elevation of about 50 ft., by gravity. As the system extended to take in contiguous

territory, three separate high-service areas supplied by booster pumps were developed so that the elevations now served range from sea level to 275 ft. above.

In 1933 it became necessary to increase pressures throughout the original system. This was accomplished by discontinuing gravity feed and returning the water from the basins to the pump station where high-service pumps were installed which delivered the water at greater pressure to the distribution system.

The original filter plant consisted of five 0.5-mgd. units. An additional unit was added in 1929 and two more units in 1937. Also at this time the original filter house, which was of wood construction, was replaced with a brick structure.

Basis of Study

The data on pipe and valves were compiled from a study made for the purpose of listing all pipe and valves that had been retired over the life of the property. The study was made coincidentally with an inventory of existing mains. Company records pertaining to size, kind and date of installation were fairly complete over the entire plant life. Existing retirement records were checked and supplemented by a comparison of pipe and valves installed with the present existence by specific locations.

The record on valves has not been carried forward beyond the date of the original study. This record is through Dec. 31, 1930.

Mortality Survival Study

Mortality studies were made of mains and valves. Table 1 is a summary of the pipe installed, the amount retired and that still in service, as well as other pertinent data. Figures 1 and

2 show the mortality survival curves covering the amount and classification of pipe grouped as shown.

Table 2 and Figure 3 represent a similar study of valves.

A brief summary of Class B facilities covering the major items is given below.

Causes of Retirement

There exists no complete record from which could be determined the causes of retirement of mains and valves.

Acknowledgments

The collection and compilation of data pertaining to the Alexandria Water Company were carried out by the personnel of the American Water Works and Electric Company, Inc.

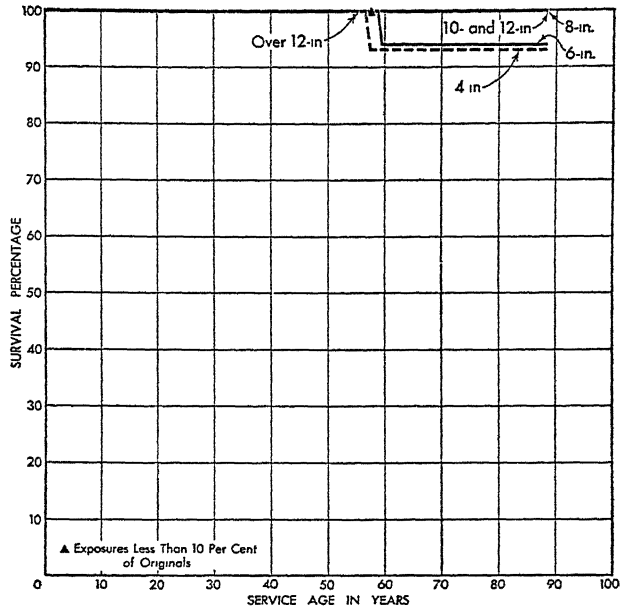


FIG. 3. Mortality Survival Curve—4-20-in. Gate Valves—Alexandria, Virginia

BASE: Unit	SURVIVAL: 1852-1940	
SIZE in.	EXPOSURES Units	RETIREMENTS Units
4	156	2
6	182	1
8	49	0
10 and 12	54	0
Over 12	8	0

SUMMARY OF CLASS B FACILITIES ALEXANDRIA, VIRGINIA

Impounding Reservoirs

Barcroft Reservoir—On Holmes Run, concrete masonry dam, 500 ft. long, maximum height 68 ft., capacity 617 mil.gal. Constructed in 1915 and still in service.

Aqueducts

Cameron Raceway—From diversion dam to pumping station, 9,000 ft. long, 12 to 15 ft. wide, 3 ft. deep. Originally constructed in 1800, straightened in 1866, 1,250 ft. relocated in 1875 and still in service.

Taylor's Run Aqueduct—Section of above raceway over Taylor's Run, concrete filled brick arches on steel I beams; 40 ft. long, 20 ft.

wide and 8 ft. high. Built in 1893 and still in service.

Purification Plant

Two wood sedimentation tanks, 44 ft. in diameter by 16 ft. high. Three wood coagulating tanks, 5 ft. in diameter by 5 ft. high. Six wood filter units, 15 ft. in diameter by 8 ft. high. Chemical feed equipment. Constructed in 1918 and still in service.

Pumping Equipment

No. 1—Reciprocating pump, driven by water wheel, capacity 1 mgd. at 81-ft. head. Installed in 1851, original water wheel replaced in 1902, pump and water wheel still in service.

TABLE 2
SUMMARY OF VALVES
ALEXANDRIA, VIRGINIA

Size, in.	Number Installed	Number Identified	Number Retired	Number in Service	Year of First Installation	Average Age yr.
1	4	4	0	4	1926	4.5
2	50	25	0	25	1912	5.5
2½	1	1	0	1	1926	4.5
3	5	5	0	5	1925	5.5
4	224	156	2	154	1852	35.4
6	314	182	1	181	1852	22.4
8	58	49	0	49	1852	24.8
10	41	36	0	36	1852	18.0
12	26	18	0	18	1885	20.8
16	6	5	0	5	1885	40.7
20	3	3	0	3	1885	38.5
TOTAL	732	484	3	481		25.5
Percentage of Total		100.00	0.62	99.38		

Mortality Survival Ratios

Size, in.	Number	Period Covered, yr.	Percentage
1-3	35	28.5	100.000
4	156	88.5	93.333
6	182	88.5	94.118
8	49	88.5	100.000
10 and 12	54	88.5	100.000
Over 12	8	55.5	100.000
TOTAL	484		

SUMMARY OF CLASS B FACILITIES (contd.)

Pumping Equipment (contd.)

No. 2—Steam engine-driven pump, capacity 1.5 mgd. at 81-ft. head. Installed in 1898 and still in service.

No. 3—Steam turbine-driven centrifugal pump, capacity 3 mgd. at 110-ft. head. Installed in 1928 and still in service.

No. 4—Water turbine-driven centrifugal pump, capacity 1.3 mgd. at 105-ft. head. Installed in 1928, replaced in 1937 by diesel unit. Pump in stock, turbine \$100 salvage.

No. 5—Motor-driven centrifugal pump, capacity 0.3 mgd. at 192-ft. head, 20-hp. motor. Installed in 1928 and still in service.

No. 6—Motor-driven centrifugal pump, capacity 0.3 mgd. at 253-ft. head, 30-hp.

motor. Installed in 1929 and still in service.

No. 7—Motor-driven centrifugal pump, capacity 0.14 mgd. at 268-ft. head, 15-hp. motor. Installed in 1927 and still in service.

No. 8—Motor-driven centrifugal pump, capacity 0.14 mgd. at 130-ft. head, 7.5-hp. motor. Installed in 1927 and still in service.

Wash Water Pump—Motor-driven centrifugal pump, capacity 0.5 mgd. at 55-ft. head, 10-hp. motor. Installed in 1918 and still in service.

Seminary Station—Motor-driven triplex pump, 7.5-hp. motor. Installed in 1928 and still in service.

Belle Haven Station—Small vertical deep well pump, 3-hp. motor. Installed in 1927 and still in service.

SUMMARY OF CLASS B FACILITIES (contd.)

Distribution Reservoirs

No. 1 Reservoir—Open, excavated, brick lined, 182-ft. square reservoir; capacity 2.5 mil. gal., 17 ft. deep. Constructed in 1852 and still in service.

No. 2 Reservoir—Open, excavated, stone-paved reservoir; capacity 14 mil.gal., 337 ft. wide by 500 ft. long, 17 ft. deep. Constructed in 1875 and still in service.

St. Elmo Reservoir—Covered reinforced concrete reservoir; capacity 0.7 mil.gal., 70.67 ft. wide by 94.67 ft. long, 16.5 ft. deep. Constructed in 1927 and still in service.

Tanks and Standpipes

Jefferson Park Standpipe—Covered steel standpipe, capacity 705,000 gal., 40 ft. in diameter by 75 ft. high. Erected in 1928 and still in service.

Seminary Elevated Tank—Covered steel elevated tank, capacity 50,000 gal., 18 ft. in diameter by 20 ft. deep, 50 ft. to flow line. Erected in 1913 and still in service.

Belle Haven Elevated Tank—Covered wood tank, capacity 20,000 gal.; 16 ft. in diameter by 13.33 ft. deep, 50 ft. to flow line. Erected in 1927 and still in service.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
ALEXANDRIA, VIRGINIA

MAINS

4-IN. CAST-IRON UNLINED MAINS

Year	Feet			Year	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1852	14,032	13,996	36	1902	147	147	0
1853	933	933	0	1903	542	542	0
1856	307	307	0	1904	1,856	1,856	0
1858	627	627	0	1905	1,374	1,374	0
1869	323	323	0	1907	2,027	2,027	0
1870	602	591	11	1908	11,555	11,555	0
1871	1,260	1,260	0	1909	2,516	2,516	0
1875	387	387	0	1910	10,880	10,880	0
1878	409	409	0	1911	2,410	2,410	0
1879	865	865	0	1912	2,451	2,451	0
1880	1,508	1,508	0	1913	2,892	2,892	0
1881	316	316	0	1914	309	309	0
1882	420	420	0	1916	378	378	0
1884	2,814	2,814	0	1918	202	202	0
1885	2,570	2,570	0	1919	29	29	0
1886	309	309	0	1920	20	20	0
1887	330	330	0	1921	283	283	0
1888	2,564	2,540	24	1923	192	192	0
1889	1,149	1,149	0	1925	11	11	0
1891	2,842	2,842	0	1926	468	468	0
1892	932	932	0	1927	6	6	0
1893	1,863	1,863	0	1928	209	209	0
1894	6,120	6,120	0	1929	203	203	0
1895	1,390	766	624	1940	0	0	0
1896	1,420	1,206	214				
1897	1,941	1,941	0	SUBTOTAL	97,978	96,553	1,425
1898	2,226	2,226	0	Unknown	74	0	74
1899	3,550	3,034	516				
1900	420	420	0	TOTAL	98,052	96,553	1,499
1901	2,589	2,589	0				

SURVIVAL AND RETIREMENT

4-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years

<i>Year</i> <i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Year</i> <i>Installed</i>	<i>Feet</i>	<i>Year</i>
1852	36	1909	1895	624	1907
1870	11	1897	1896	214	1907
1888	24	1911	1899	516	1939

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i> <i>Installed</i>	<i>Feet</i>			<i>Year</i> <i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1852	10,702	9,454	1,248	1915	2,949	2,949	0
1853	313	313	0	1916	3,090	3,090	0
1877	420	420	0	1918	5,516	5,516	0
1878	409	409	0	1919	2,858	2,858	0
1885	244	244	0	1920	1,870	1,870	0
1886	423	423	0	1921	1,439	1,439	0
1888	1,701	1,701	0	1922	4,191	4,191	0
1890	410	0	410	1923	6,249	6,249	0
1892	2,851	2,851	0	1924	6,189	6,189	0
1893	774	774	0	1925	3,587	3,587	0
1896	875	875	0	1926	9,694	9,694	0
1897	3,695	3,695	0	1927	11,930	11,930	0
1898	1,811	1,811	0	1928	10,740	10,740	0
1899	711	711	0	1929	4,434	4,434	0
1902	377	377	0	1940	0	0	0
1903	2,314	2,314	0				
1904	753	753	0	SUBTOTAL	125,650	123,992	1,658
1905	434	434	0	Unknown	201	0	201
1906	1,530	1,530	0				
1907	2,062	2,062	0	TOTAL	125,851	123,992	1,859
1908	5,309	5,309	0				
1909	2,008	2,008	0				
1910	5,067	5,067	0				
1911	726	726	0				
1913	2,217	2,217	0				
1914	2,778	2,778	0				

Retirements by Years

<i>Year</i> <i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1852	24	1909	1,224	1913
1890	410	1914		

8-IN. CAST-IRON UNLINED MAINS

<i>Year</i> <i>Installed</i>	<i>Feet</i>			<i>Year</i> <i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1852	4,776	4,776	0	1926	4,750	4,750	0
1870	1,317	867	450	1927	9,580	9,580	0
1872	54	0	54	1928	262	262	0
1897	1,244	1,244	0	1940	0	0	0
1898	1,961	1,937	24				
1902	450	450	0	TOTAL	30,169	29,641	528
1905	417	417	0				
1907	24	24	0				
1916	1,876	1,876	0				
1918	978	978	0				
1919	394	394	0				
1920	882	882	0				
1921	38	38	0				
1922	1,166	1,166	0				

Retirements by Years

<i>Year</i> <i>Installed</i>	<i>Feet</i>	<i>Year</i>
1870	450	1902
1872	54	1885
1898	24	1907

10-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1852	3,908	3,884	24
1885	3,450	3,432	18
1905	938	938	0
1927	3,969	3,969	0
1928	11,139	11,139	0
1940	0	0	0
TOTAL	23,404	23,362	42

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1852	24	1910
1885	18	1914

12-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	1,719	1,677	42
1897	1,900	1,900	0
1906	1,425	1,425	0
1908	916	916	0
1911	4,523	4,523	0
1920	414	414	0
1922	1,749	1,749	0
1923	3,614	3,614	0
1926	568	568	0
1927	2,424	2,424	0
1928	2,765	2,765	0
1940	0	0	0
TOTAL	22,017	21,975	42

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1885	42	1914

16-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	1,443	1,443	0
1897	1,675	1,675	0
1928	211	211	0
1940	0	0	0
TOTAL	3,329	3,329	0

20-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	3,308	3,308	0
1905	938	938	0
1940	0	0	0
TOTAL	4,246	4,246	0

2-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	8,327	7,412	915
1931	2,272	2,151	121
1932	833	559	274
1933	3,299	1,607	1,692
1934	1,409	1,409	0
1935	1,645	1,615	30
1936	791	791	0
1937	703	703	0
1938	3,392	3,392	0
1939	3,200	3,200	0
1940	1,521	1,521	0
TOTAL	27,392	24,360	3,032

Retirements by Years

Year	Feet	Year	Feet	Year
<i>Installed</i>				
1930	781	1936	134	1938
1931	121	1938		
1932	274	1936		
1933	1,692	1936		
1935	30	1936		

6-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	3,305	3,305	0
1931	3,041	3,041	0
1933	292	292	0
1934	84	84	0
1935	8,120	8,120	0
1936	12,249	12,249	0
1937	7,897	7,897	0
1938	8,978	8,978	0
1939	8,224	8,224	0
1940	10,906	10,906	0
TOTAL	63,096	63,096	0

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	789	789	0
1931	348	348	0
1933	36	36	0
1935	132	132	0
1936	6,085	6,085	0
1937	2,113	2,113	0
1938	1,373	1,373	0
1939	3,160	3,160	0
1940	4,657	4,657	0
TOTAL	18,693	18,693	0

12-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	50	50	0
1937	1,405	1,405	0
1939	41	41	0
1940	559	559	0
TOTAL	2,061	2,061	0

 $\frac{3}{4}$ -IN. GALVANIZED STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1923	88	88	0
1924	261	261	0
1940	0	0	0
TOTAL	349	349	0

1-IN. GALVANIZED STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1924	266	266	0
1940	0	0	0
TOTAL	266	266	0

1 $\frac{1}{2}$ -IN. GALVANIZED STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1923	153	153	0
1924	1,127	654	473
TOTAL	1,280	807	473

1 $\frac{1}{2}$ -IN. GALVANIZED STEEL MAINS (contd.)

Retirements by Years		
Year	Feet	Year
<i>Installed</i>		
1924	473	1936

2-IN. GALVANIZED STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1918	276	276	0
1919	173	173	0
1922	821	821	0
1924	4,717	4,717	0
1925	385	385	0
1926	2,938	2,938	0
1927	810	810	0
1928	765	765	0
1929	1,363	0	1,363
1940	0	0	0
TOTAL	12,248	10,885	1,363

Retirements by Years		
Year	Feet	Year
<i>Installed</i>		
1929	1,363	1936

2 $\frac{1}{2}$ -IN. GALVANIZED STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1921	258	0	258
1926	1,115	1,115	0
1940	0	0	0
TOTAL	1,373	1,115	258

Retirements by Years		
Year	Feet	Year
<i>Installed</i>		
1921	258	1935

3-IN. GALVANIZED STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1924	508	508	0
1927	952	952	0
1929	189	189	0
1940	0	0	0
TOTAL	1,649	1,649	0

4-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1913	1,222	0	1,222
1924	3,027	1,573	1,454
1940	0	0	0
TOTAL	4,249	1,573	2,676

Retirements by Years				
Year	Feet	Year	Feet	Year
Installed				
1913	1,222	1928		
1924	145	1936	1,309	1939

1-IN. LEAD MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1923	16	16	0
1940	0	0	0
TOTAL	16	16	0

1½-IN. LEAD MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1926	18	18	0
1940	0	0	0
TOTAL	18	18	0

1½-IN. GALVANIZED WROUGHT-IRON MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1852	100	0	100
1853	400	0	400
1859	1,200	0	1,200
1924	890	740	150
1925	445	445	0
1927	96	96	0
1940	0	0	0
TOTAL	3,131	1,281	1,850

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year	Feet
Installed							
1852	100	1880					
1853	400	1893					
1859	425	1871	375	1877	400	1885	
1924	150	1937					

2-IN. GALVANIZED WROUGHT-IRON MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1852	650	0	650
1853	725	0	725
1860	2,150	0	2,150
1866	444	0	444
1867	1,522	0	1,522
1868	768	0	768
1869	243	0	243
1871	111	0	111
1925	2,753	2,753	0
1940	0	0	0
TOTAL	9,366	2,753	6,613

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year	Feet
Installed							
1852	650	1875					
1853	725	1884					
1860	1,200	1885	950	1890			
1866	198	1880	246	1893			
1867	450	1880	186	1893	436	1894	
	450	1895					
1868	207	1882	205	1888	158	1892	
	198	1896					
1869	243	1896					
1871	111	1896					

2½-IN. GALVANIZED WROUGHT-IRON MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1866	600	0	600
1940	0	0	0
TOTAL	600	0	600

Retirements by Years

Year	Feet	Year	Feet
Installed			
1866	600	1886	

3-IN. GALVANIZED WROUGHT-IRON MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1925	1,643	1,643	0
1940	0	0	0
TOTAL	1,643	1,643	0

VALVES

1-IN. VALVES			
Year	Number		
Installed	Installed	In Service	Retired
1926	4	4	0
1930	0	0	0
	—	—	—
TOTAL	4	4	0

2-IN. VALVES			
Year	Number		
Installed	Installed	In Service	Retired
1912	1	1	0
1918	1	1	0
1925	13	13	0
1926	3	3	0
1927	5	5	0
1928	2	2	0
1930	0	0	0
	—	—	—
SUBTOTAL	25	25	0
Unknown	25	25	0
	—	—	—
TOTAL	50	50	0

2½-IN. VALVES			
Year	Number		
Installed	Installed	In Service	Retired
1926	1	1	0
1930	0	0	0
	—	—	—
TOTAL	1	1	0

3-IN. VALVES			
Year	Number		
Installed	Installed	In Service	Retired
1925	5	5	0
1930	0	0	0
	—	—	—
TOTAL	5	5	0

4-IN. VALVES			
Year	Number		
Installed	Installed	In Service	Retired
1852	20	18	2
1869	1	1	0
1870	1	1	0
1871	1	1	0

4-IN. VALVES (contd.)			
Year	Number		
Installed	Installed	In Service	Retired
1875	1	1	0
1878	2	2	0
1880	3	3	0
1881	1	1	0
1884	2	2	0
1885	2	2	0
1886	1	1	0
1887	2	2	0
1888	3	3	0
1889	3	3	0
1891	3	3	0
1892	1	1	0
1893	4	4	0
1894	6	6	0
1895	3	3	0
1896	2	2	0
1897	9	9	0
1898	7	7	0
1899	12	12	0
1900	1	1	0
1901	1	1	0
1902	1	1	0
1903	1	1	0
1904	1	1	0
1905	3	3	0
1906	2	2	0
1907	14	14	0
1908	12	12	0
1909	2	2	0
1910	2	2	0
1911	6	6	0
1912	3	3	0
1913	6	6	0
1914	2	2	0
1917	1	1	0
1918	2	2	0
1920	1	1	0
1926	2	2	0
1927	1	1	0
1930	2	2	0
	—	—	—
SUBTOTAL	156	154	2
Unknown	68	68	0
	—	—	—
TOTAL	224	222	2

Retirements by Years		
Year	Number	Year
Installed		
1852	2	1910

6-IN. VALVES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1852	14	13	1
1876	1	1	0
1878	1	1	0
1879	1	1	0
1882	1	1	0
1885	1	1	0
1886	2	2	0
1888	3	3	0
1892	4	4	0
1893	1	1	0
1896	2	2	0
1897	21	21	0
1898	4	4	0
1899	2	2	0
1902	1	1	0
1903	6	6	0
1904	3	3	0
1905	1	1	0
1906	3	3	0
1907	4	4	0
1908	5	5	0
1910	2	2	0
1911	1	1	0
1912	1	1	0
1913	6	6	0
1914	9	9	0
1915	8	8	0
1916	5	5	0
1917	1	1	0
1918	5	5	0
1920	1	1	0
1921	3	3	0
1923	1	1	0
1926	6	6	0
1927	23	23	0
1928	21	21	0
1929	6	6	0
1930	2	2	0
<hr/>			
SUBTOTAL	182	181	1
Unknown	132	132	0
<hr/>			
TOTAL	314	313	1

Retirements by Years

<i>Year</i>	<i>Number</i>	<i>Year</i>
<i>Installed</i>		
1852	1	1911

8-IN. VALVES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1852	8	8	0
1870	2	2	0
1897	2	2	0
1898	5	5	0
1905	1	1	0
1906	1	1	0
1912	1	1	0
1916	4	4	0
1919	2	2	0
1926	5	5	0
1927	18	18	0
1930	0	0	0
<hr/>			
SUBTOTAL	49	49	0
Unknown	9	9	0
<hr/>			
TOTAL	58	58	0

10-IN. VALVES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1852	3	3	0
1885	7	7	0
1906	1	1	0
1927	8	8	0
1928	17	17	0
1930	0	0	0
<hr/>			
SUBTOTAL	36	36	0
Unknown	5	5	0
<hr/>			
TOTAL	41	41	0

12-IN. VALVES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	3	3	0
1897	3	3	0
1906	2	2	0
1908	1	1	0
1911	2	2	0
1923	1	1	0
1926	1	1	0
1927	2	2	0
1928	3	3	0

SURVIVAL AND RETIREMENT

12-IN. VALVES (contd.)

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	0	0	0
	—	—	—
SUBTOTAL	18	18	0
Unknown	8	8	0
	—	—	—
TOTAL	26	26	0

16-IN. VALVES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	3	3	0
1897	2	2	0
1930	0	0	0
	—	—	—

16-IN. VALVES (contd.)

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
SUBTOTAL	5	5	0
Unknown	1	1	0
	—	—	—
TOTAL	6	6	0

20-IN. VALVES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	2	2	0
1906	1	1	0
1930	0	0	0
	—	—	—
TOTAL	3	3	0

Babylon, New York

As of December 31, 1940

THE Babylon plant of the New York Water Service Corporation is a private plant serving water in the incorporated villages of Babylon and Lindenhurst, the communities of North and West Babylon and environments located in Suffolk County on Long Island, N.Y.

The communities served are largely residential in character. There are some small industries along the south shore of Long Island, a part of the New York Metropolitan area. Within the area, as of the date of the study, there were 1,751 services furnishing water to a population of 12,900. Sales

of water during 1940 averaged 0.3 mgd. or about 23 gpd. per capita.

Development of the Existing System

A predecessor of the present company, the Sumpwams Water Works Company was incorporated on Dec. 19, 1892. Plant construction was started early in 1893 and the first water service was rendered in September 1893. In May 1930 control of the company was acquired by Francis W. Collins from whom the New York Water Service Corporation purchased it on June 24, 1930. In September 1930, the Sumpwams Water Works Com-

TABLE 1
SUMMARY OF MAINS
BABYLON, NEW YORK

Size, <i>in.</i>	Kind	No. of Feet Installed	Percent- age of Total	No. of Feet Retired	Percent- age of Total	No. of Feet in Service	Percent- age of Total	Year of First In- stallation	Average Age, <i>yr.</i>
4	Cast-iron unlined	51,808	21.0	9	1.6	51,799	21.1	1893	27.6
6		137,307	55.7	449	81.9	136,858	55.6	1893	22.5
8		17,823	7.2	90	16.5	17,733	7.2	1893	29.0
10		22,274	9.0	0	0	22,274	9.0	1926	13.9
12		779	0.3	0	0	779	0.3	1926	12.8
4	Cast-iron cement-lined	30	0.0	0	0	30	0.0	1931	8.6
6		14,456	5.9	0	0	14,456	5.9	1930	4.4
8		1,393	0.6	0	0	1,393	0.6	1930	8.8
12		848	0.3	0	0	848	0.3	1930	9.8
TOTAL		246,718	100.0	548	100.0	246,170	100.0		22.0
Percentage of Total		100.00		0.22		99.78			
Average Size, <i>in.</i>		6.14		6.30		6.10			

TABLE 1 (contd.)
Mortality Survival Ratios

Size, in.	Kind	Number of Feet	Period Covered, yr.	Percentage
4	Cast-iron unlined	51,808	47.5	99.972
6		137,307	47.5	99.258
8		17,823	47.5	98.433
10 and 12		23,053	14.5	100.000
4-12	Cast-iron cement-lined	16,727	10.5	100.000
TOTAL		246,718		

TABLE 2
SUMMARY OF VALVES
BABYLON, NEW YORK

Size, in.	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, yr.
4	84	1	83	1893	28.4
6	194	1	193	1893	21.3
8	29	1	28	1893	30.4
10	10	0	10	1926	14.0
12	4	0	4	1926	11.5
TOTAL	321	3	318		23.6
Percentage of Total	100.00	0.93	99.07		

Mortality Survival Ratios

Size, in.	Number Installed	Period Covered, yr.	Percentage
4	84	47.5	93.333
6	194	47.5	96.296
8	29	47.5	95.000
10 and 12	14	14.5	100.000
TOTAL	321		

pany was merged with and its property became the Babylon plant of the New York Water Service Corporation. This corporation, controlled by the Federal Water and Gas Corporation, owns a number of other plants on Long Island and in other parts of the state.

The company secures its supply from wells. The original supply works, known as the Smith Street station and located in the village of Babylon, consisted of four 8-in. wells, 60 ft. deep. It was installed in 1903 and had a combined average yield of 1.2 mgd. Four

TABLE 3
SUMMARY OF HYDRANTS
BABYLON, NEW YORK

Size, in.	Type	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, yr.
4	Two 2½-in. nozzle	224	55	169	1893	18.0
4	Two 2½-in. and steamer nozzle	129	44	85	1926	10.9
5	Two 2½-in. nozzle	3	0	3	1932	6.2
5	Two 2½-in. and steamer nozzle	29	1	28	1926	10.7
TOTAL		385	100	285		15.1
Percentage of Total		100.00	25.97	74.03		

Mortality Survival Ratios

Size, in.	Number Installed	Period Covered, yr.	Percentage
4	353	46.5	9.030
5	32	14.5	94.445
TOTAL	385		

TABLE 4
CAUSES OF RETIREMENT OF MAINS
BABYLON, NEW YORK

Size, <i>in.</i>	Kind	Length, <i>ft.</i>	Life, <i>yr.</i>	Cause of Retirement	Salvage, <i>ft.</i>
4	Cast-iron unlined	9	22.5	Lowering main	9
		—			—
		9			9
6	Cast-iron unlined	9	4.5	Old pump station abandoned	0
		10	9.5	Lowering main	10
		70	21.5	Canal cut through road	0
		80	34.5	Old pump station abandoned	0
		75	43.5	New bridge construction	0
		205	47.5	Old pump station abandoned	0
		—	—	—	—
449			10		
8	Cast-iron unlined	90	34.5	Old pump station abandoned	0
		—			—
		90			0
TOTAL		548			19

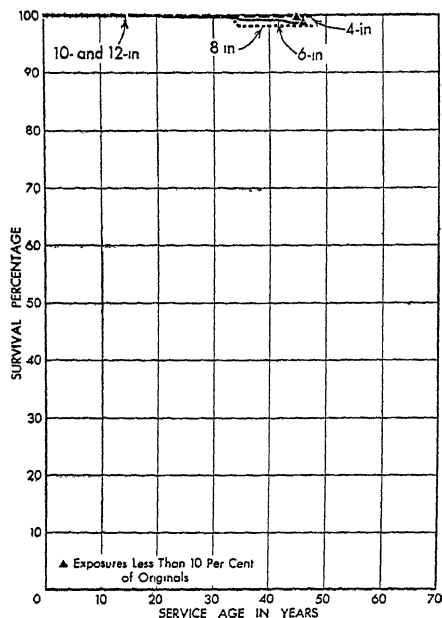


FIG. 1. Mortality Survival Curve—4-12-in. Cast-Iron Unlined Mains—Babylon, New York

BASE: Feet SIZE	SURVIVAL: 1893-1940	
	EXPOSURES	RETIREMENTS
<i>in.</i>	<i>ft.</i>	<i>ft.</i>
4	51,808	9
6	137,307	449
8	17,823	90
10 and 12	23,053	0

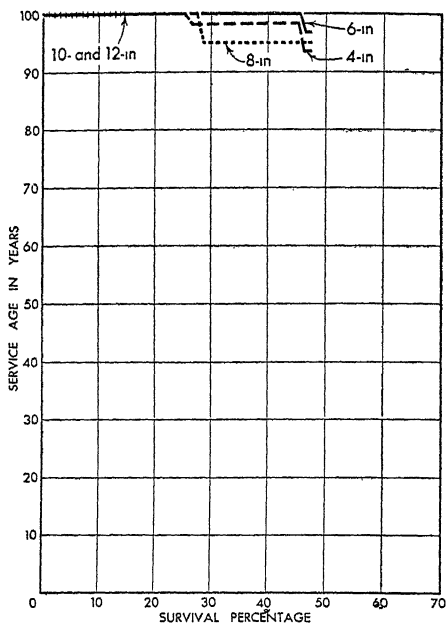


FIG. 2. Mortality Survival Curve—4-12-in. Valves—Babylon, New York

BASE: Unit SIZE	SURVIVAL: 1893-1940	
	EXPOSURES	RETIREMENTS
<i>in.</i>	<i>Units</i>	<i>Units</i>
4	84	1
6	194	1
8	29	1
10 and 12	14	0

additional 8-in. wells, having about the same yield, were installed in 1923.

Water was originally pumped from the wells into the distribution mains by three duplex steam pumps with steam furnished from two horizontal return tubular boilers. From 1927 until 1933 the Smith Street wells were held in reserve and at the later date the station and equipment were dismantled and retired. In 1940, however, the four newer wells were rehabilitated and a new pump station, housing two 300-gpm. at 200-ft. head motor-driven cen-

trifugal pumps, was constructed and placed in service.

In 1927 a new pump station was built in the town of Babylon, known as the West Babylon pump station. This station has six 8-in. wells, 52 ft. deep, with a 20-ft. screen, having a combined average yield of 2.0 mgd. Water is pumped from the wells to the distribution system by two 8-in. centrifugal pumps in series. These are rated 2,000 gpm. at a 240-ft. head and are driven by a 200-hp. diesel engine, or by a two-stage 650-gpm. centrifugal

pump driven by a 65-hp. gasoline engine.

The distribution system contains a 300,000-gal. elevated steel tank erected in 1931 in Babylon.

As of Dec. 31, 1940, there were in service approximately 51.75 mi. of pipe, from 1 to 12 in. in diameter, largely of Class B cast-iron pipe; 366 valves and 285 fire hydrants. Services numbered 1,751 approximately 75 per cent of which were metered.

Basis of Study

The records of installation and retirement of cast-iron pipe, valves and hydrants are substantially complete from the beginning of the original company.

Mortality Survival Study

Mortality studies were made of cast-iron mains, valves and hydrants. Table 1 is a summary of cast-iron mains installed, retired and remaining in service, as well as their average ages, average sizes, lengths of records and mortality survival ratios. Figure 1 shows the mortality survival curves covering the above record.

Tables 2 and 3 are similar summaries of gate valves and hydrants with Figs. 2 and 3 representing the corresponding mortality survival curves.

Causes of Retirement

The causes of the retirements of mains, valves and hydrants are shown in Tables 4, 5 and 6, respectively.

It may be noted that the major cause of retirement of mains was the abandonment of a pumping station. It may further be noted that an important rea-

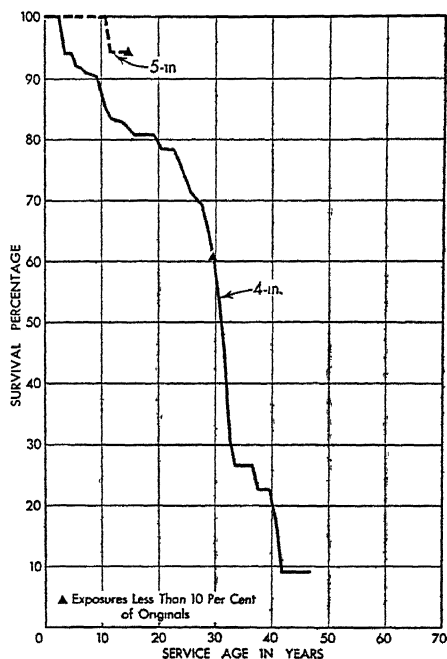


FIG. 3. Mortality Survival Curve—4- and 5-in. Hydrants—Babylon, New York

BASE: Unit SIZE	SURVIVAL: 1893-1940	
	EXPOSURES	RETIREMENTS
in.	Units	Units
4	353	99
5	32	1

son for retirement of hydrants was non-renewal of fire hydrant contracts. While from an accounting standpoint such may properly be a retirement, from a strict mortality standpoint it properly should not be classed as a fulfillment of the life of such facility.

Acknowledgment

The collection and compilation of data for the study in the Babylon plant were under the supervision of E. L. Heyser, Chief Valuation Engineer, New York Water Service Corporation.

SURVIVAL AND RETIREMENT

TABLE 5
CAUSES OF RETIREMENT OF VALVES
BABYLON, NEW YORK

Size, in	Number	Life, yr.	Cause of Retirement	Number Salvaged
4	1	46.5	Broken	0
	—			—
	1			0
6	1	46.5	Broken	0
	—			—
	1			0
8	1	28.5	Broken	0
	—			—
	1			0
	TOTAL 3			0

TABLE 6
CAUSES OF RETIREMENT OF HYDRANTS
BABYLON, NEW YORK

Number	Cause of Retirement	Salvaged
2	Leaking	0
7	Hit by automobile and broken	1
11	Relocated	5
43	Village contract not renewed	43
37	No reason	—
TOTAL 100		49

SUMMARY OF INSTALLATIONS AND RETIREMENTS
BABYLON, NEW YORK

MAINS

4-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	2,392	2,392	0
1895	1,271	1,271	0
1896	2,008	2,008	0
1897	498	498	0
1898	1,200	1,200	0
1899	4,198	4,198	0
1900	348	348	0
1901	1,884	1,884	0
1902	1,014	1,014	0
1903	864	864	0
1904	384	384	0
1906	1,309	1,309	0
1907	1,046	1,046	0
1909	932	932	0
1910	2,423	2,423	0
1911	2,050	2,050	0
1912	4,911	4,902	9
1913	938	938	0
1914	1,937	1,937	0
1916	548	548	0
1920	360	360	0
1923	3,826	3,826	0
1924	749	749	0
1926	3,574	3,574	0
1927	1,309	1,309	0
1928	5,761	5,761	0
1929	3,383	3,383	0
1930	691	691	0
1940	0	0	0
TOTAL	51,808	51,799	9

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>
Installed		
1912	9	1934

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	11,829	11,469	360
1895	2,515	2,515	0
1896	1,774	1,774	0
1899	1,500	1,500	0

6-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1904	1,678	1,678	0
1906	515	515	0
1908	4,752	4,752	0
1909	829	829	0
1910	1,402	1,402	0
1911	3,067	3,067	0
1912	23,355	23,285	70
1913	1,139	1,139	0
1914	1,958	1,958	0
1915	911	911	0
1916	241	241	0
1922	990	990	0
1923	8,644	8,635	9
1924	2,088	2,088	0
1925	4,155	4,145	10
1926	19,685	19,685	0
1927	14,021	14,021	0
1928	18,393	18,393	0
1929	11,568	11,568	0
1930	298	298	0
1940	0	0	0
TOTAL	137,307	136,858	449

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
Installed						
1893	80	1927	75	1936	205	1940
1912	70	1933				
1923	9	1927				
1925	10	1934				

8-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	5,742	5,652	90
1912	5,815	5,815	0
1927	2,700	2,700	0
1928	2,910	2,910	0
1929	656	656	0
1940	0	0	0
TOTAL	17,823	17,733	90

8-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years			
Year	Feet		Year
Installed	Installed	In Service	Retired
1893	90		1927

10-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1926	8,155	8,155	0
1927	14,119	14,119	0
1940	0	0	0
TOTAL	22,274	22,274	0

12-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1926	38	38	0
1927	449	449	0
1929	292	292	0
1940	0	0	0
TOTAL	779	779	0

4-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1931	21	21	0
1934	9	9	0
1940	0	0	0
TOTAL	30	30	0

6-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1930	894	894	0
1931	2,925	2,925	0
1932	350	350	0
1933	110	110	0
1934	55	55	0
1935	899	899	0
1936	251	251	0
1937	1,874	1,874	0
1938	1,833	1,833	0
1939	2,742	2,742	0
1940	2,523	2,523	0
TOTAL	14,456	14,456	0

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1930	31	31	0
1931	1,208	1,208	0
1936	96	96	0
1940	58	58	0
TOTAL	1,393	1,393	0

12-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1930	754	754	0
1931	37	37	0
1940	57	57	0
TOTAL	848	848	0

VALVES

4-IN. VALVES

Year	Number		
Installed	Installed	In Service	Retired
1893	15	14	1
1895	1	1	0
1896	2	2	0
1899	6	6	0
1901	3	3	0
1904	1	1	0
1906	1	1	0
1907	1	1	0
1909	2	2	0
1910	2	2	0
1911	2	2	0
1912	11	11	0
1913	4	4	0
1914	3	3	0

4-IN. VALVES (contd.)

Year	Number		
Installed	Installed	In Service	Retired
1916	1	1	0
1920	1	1	0
1923	8	8	0
1926	5	5	0
1927	3	3	0
1928	3	3	0
1929	2	2	0
1930	2	2	0
1931	1	1	0
1936	1	1	0
1937	2	2	0
1939	1	1	0
1940	0	0	0
TOTAL	84	83	1

4-IN. VALVES (contd.)

<i>Retirements by Years</i>		
<i>Year Installed</i>	<i>Number</i>	<i>Year</i>
1893	1	1939

6-IN. VALVES

<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	27	26	1
1895	4	4	0
1896	3	3	0
1904	1	1	0
1906	1	1	0
1908	6	6	0
1909	2	2	0
1910	2	2	0
1911	3	3	0
1912	22	22	0
1913	3	3	0
1914	2	2	0
1915	1	1	0
1922	1	1	0
1923	7	7	0
1924	2	2	0
1925	6	6	0
1926	19	19	0
1927	16	16	0
1928	22	22	0
1929	13	13	0
1930	1	1	0
1931	4	4	0
1932	1	1	0
1933	2	2	0
1935	2	2	0
1937	2	2	0
1938	4	4	0
1939	8	8	0
1940	7	7	0
TOTAL	194	193	1

Retirements by Years

<i>Year Installed</i>	<i>Number</i>	<i>Year</i>
1893	1	1939

8-IN. VALVES

<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	11	11	0
1912	9	8	1
1927	4	4	0
1928	2	2	0
1929	1	1	0

8-IN. VALVES (contd.)

<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	1	1	0
1940	1	1	0
TOTAL	29	28	1

Retirements by Years

<i>Year Installed</i>	<i>Number</i>	<i>Year</i>
1912	1	1940

10-IN. VALVES

<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	5	5	0
1927	5	5	0
1940	0	0	0
TOTAL	10	10	0

12-IN. VALVES

<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	1	1	0
1929	1	1	0
1930	1	1	0
1931	1	1	0
1940	0	0	0
TOTAL	4	4	0

HYDRANTS

4-IN. HYDRANTS—TWO HOSE NOZZLES

<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	10	0	10
1894	10	1	9
1895	5	0	5
1896	3	1	2
1897	2	0	2
1898	1	0	1
1899	3	0	3
1901	3	1	2
1902	2	0	2
1904	4	4	0
1907	1	1	0
1908	4	2	2
1909	1	1	0
1910	1	1	0

SURVIVAL AND RETIREMENT

4-IN. HYDRANTS—TWO HOSE
NOZZLES (contd.)

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1911	3	3	0
1912	13	12	1
1915	2	2	0
1916	3	3	0
1917	2	2	0
1920	1	1	0
1922	3	3	0
1923	41	32	9
1924	13	12	1
1925	29	27	2
1926	28	26	2
1927	6	5	1
1928	17	17	0
1929	6	5	1
1930	2	2	0
1932	1	1	0
1934	1	1	0
1937	1	1	0
1940	2	2	0
<hr/>			
SUBTOTAL	224	169	55
Unknown	1	0	1
<hr/>			
TOTAL	225	169	56

Retirements by Years

Year	Num-		Num-		Num-	
<i>Installed</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>
1893	2	1923	1	1924	7	1925
1894	2	1923	2	1924	3	1925
	1	1934	1	1935		
1895	3	1923	1	1924	1	1928
1896	1	1929	1	1937		
1897	1	1917	1	1923		
1898	1	1935				
1899	1	1912	1	1924	1	1930
1901	2	1925				
1902	2	1925				
1908	1	1928	1	1933		
1912	1	1939				
1923	7	1928	2	1938		
1924	1	1938				
1925	2	1928				
1926	1	1933	1	1940		
1927	1	1937				
1929	1	1940				

4-IN. HYDRANTS—TWO HOSE NOZZLES
AND ONE STEAMER NOZZLE

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	2	2	0

4-IN. HYDRANTS—TWO HOSE NOZZLES AND
ONE STEAMER NOZZLE (contd.)

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1928	58	32	26
1929	30	14	16
1930	5	5	0
1933	2	2	0
1934	4	4	0
1935	5	5	0
1937	2	2	0
1938	1	1	0
1939	1	1	0
1940	2	2	0
<hr/>			
TOTAL	129	85	44

Retirements by Years

Year	Num-		Num-		Num-	
<i>Installed</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>
1927	1	1934	1	1935		
1928	18	1931	1	1934	6	1939
	1	1940				
1929	1	1936	1	1938	14	1939

5-IN. HYDRANTS—TWO HOSE NOZZLES

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1932	1	1	0
1935	1	1	0
1936	1	1	0
1940	0	0	0
<hr/>			
TOTAL	3	3	0

5-IN. HYDRANTS—TWO HOSE NOZZLES
AND ONE STEAMER NOZZLE

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	1	1	0
1927	14	13	1
1928	1	1	0
1929	2	2	0
1931	5	5	0
1933	2	2	0
1937	2	2	0
1938	2	2	0
1940	0	0	0
<hr/>			
TOTAL	29	28	1

Retirements by Years

Year	Number	Year
<i>Installed</i>		
1927	1	1938

Clinton, Iowa

As of December 31, 1939

THE privately-owned Clinton Water Works Company is a subsidiary of the American Water Works & Electric Company, Inc., serving the city of Clinton, Iowa, and a small area outside the city limits.

The city of Clinton, the county seat of Clinton County, is situated in the east central part of Iowa on the Mississippi River about 130 mi. west of Chicago. It was first settled in 1855 and incorporated as a village in 1857. At the time of the original construction of the Clinton Water Works, in 1874-1875, the population was 7,500. From that time until 1910 Clinton experienced a fairly steady growth, but since 1910 there has been little increase in population. The 1940 census gave the population of the city as 26,270.

Clinton was originally a lumber manufacturing center of considerable importance and had at one time what was considered the largest saw mill in the world. With the decline of the logging business on the Mississippi River the town suffered considerably, but there has been gradually built up some industrial activity of a diversified nature. The Du Pont Company has recently built a large cellophane plant on the outskirts of the city.

The territory served is therefore both residential and industrial. As of Dec. 31, 1939, there were 6,638 consumers, 91.9 per cent of whom were

served through meter measurement. There were in the system about 75 mi. of mains with 576 hydrants. The average daily pumpage during 1939 was 2.57 mil.gal. of which about 64.5 per cent was measured through consumers' meters. This pumpage is equivalent to about 99 gpd. per capita.

Development of Existing System

The original Clinton Water Works franchise was granted in 1874 and the system was built during 1874-1875. Under this franchise the company was granted the right to construct and maintain its pumping station and to develop the water supply in the public park on the river front where it has since been maintained.

The original supply was taken from the Mississippi River and filtered through boxes filled with sand which were placed in the bottom of a rectangular well 53 ft. long, 12 ft. 6 in. wide and 25 ft. deep, divided by a central wall. From the well the water flowed through a tunnel into a suction well. There is no definite record of how long this method was used.

In 1886 two artesian wells were installed and when a new contract was made in 1889 the use of Mississippi water as a regular source of supply was abandoned and wells at or adjacent to the pumping station have since that time formed the source of supply.

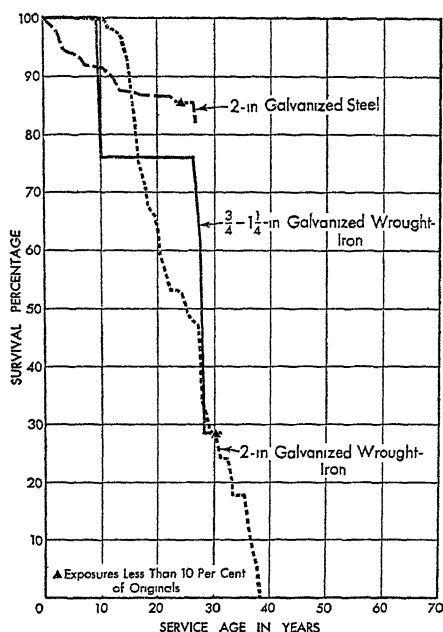


FIG. 1. Mortality Survival Curve— $\frac{3}{4}$ -2-in. Galvanized Wrought-Iron and Galvanized Steel Mains—Clinton, Iowa

BASE: Feet

SURVIVAL: 1890-1939

SIZE in.	KIND	EXPO- SURES ft.	RETIRE- MENTS ft.
$\frac{3}{4}$ -1 $\frac{1}{4}$	Galvanized Wrought-Iron	835	598
2	Galvanized Steel	57,316	7,304
2	Galvanized Wrought-Iron	22,400	16,655

The town of Lyons, immediately north of Clinton on the Mississippi River, which was later incorporated in the city of Clinton, originally had its own supply furnished by the Lyons Water Works which was built in 1875. The source of supply was the Mississippi River and there was a steam pumping plant on the bank which pumped the water into an earth embankment reservoir from which it flowed by gravity into the distribution

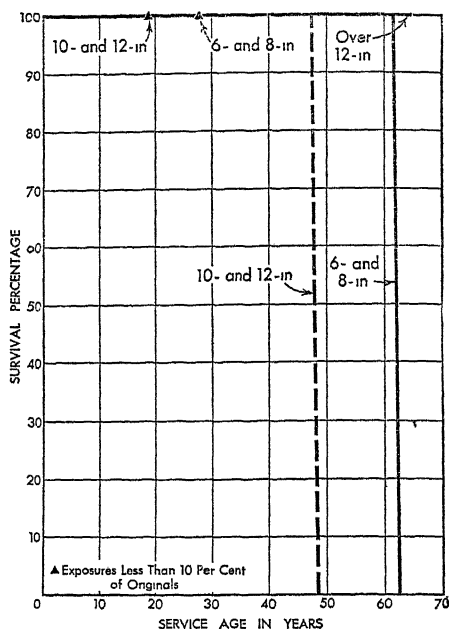


FIG. 2. Mortality Survival Curve—6-16-in. Cast-Iron Unlined Mains—Clinton, Iowa

BASE: Feet

SURVIVAL: 1875-1940

SIZE in.	EXPO- SURES ft.	RETIRE- MENTS ft.
6 and 8	66,411	12
10 and 12	4,828	276
Over 12	654	0

system. In 1891 the owners of the Clinton Water Works Company took over these works and operated them until about 1900 when the two systems were combined and supplied from the Clinton works.

For emergency service in case of insufficiency in well supply a filter system was installed in 1899 at the Clinton station to filter Mississippi River water. Its capacity was about 0.8 mgd. and consisted of low-service pumps for raising the water into a steel sedimentation tank from which treated

water flowed to the two gravity filters and thence to the clear well. There has been little occasion, however, to use these filters.

In 1926 the original pump station, which was a plain brick building, was replaced with a new building of more ornate appearance, largely because of local desire for a more pretentious building in the river front park.

The present water supply is obtained from six wells adjacent to the station which are drilled into rock to depths of from 1,135 to 2,100 ft. Water is pumped from these wells by air lift and flows through collecting pipes to a masonry suction well beneath the pump room floor. Adjacent to the pump station is a clear water reservoir originally constructed some time prior to 1900 and rebuilt and enlarged in that year to a capacity of 1.25 mil.gal.

The yield of the wells at the present time is about 6 mgd., varying in individual wells from 0.8 to 2.6 mgd. Air for pumping wells is furnished by two steam and one diesel engine-driven air compressors.

After chlorination the water is repumped to the distribution system which is in one service pressure without storage. The distributive pumping equipment is steam driven, with one 4-mgd. centrifugal pump driven by a gasoline engine for standby equipment. Standard station pressure is about 80 psi. which is raised when required for fire service to 110 psi.

Basis of Study

The data on pipe were compiled from a study made for the purpose of listing all pipe that had been retired over the

life of the property. The study was made coincidentally with an inventory of existing mains. Company records of size, kind and date of installation were only fairly complete over the early life of the system. Only fully identified pipe were included in the study.

Mortality Survival Study

Mortality studies were made only of mains. Table 1 gives a summary of the pipe installed, identified, retired and the amount remaining in service, as well as the average ages, sizes and grouped mortality survival ratios. The major part of the pipe unidentified is still in service. Figures 1 and 2 show the mortality survival curves covering the record of the pipe grouped as shown. In explanation of the fact that several of the mortality survival ratios are shown as zero, it might be pointed out that this pertains when the entire amount of the oldest pipe formerly in service is retired in the last year of the record even though most of the pipe still is in service.

A brief summary of Class B facilities, exclusive of the original construction, is given below.

Causes of Retirement

There is no complete record from which could be determined the causes of retirement of mains in Clinton.

Acknowledgment

The collection and compilation of data pertaining to the Clinton Water Works Company were done by the personnel of the American Water Works & Electric Company, Inc.

SUMMARY OF CLASS B FACILITIES

CLINTON, IOWA

Wells

No. 1—Drilled well, 5- and 8-in. diameter, 1,135 ft. deep, 250 ft. of 8-in. casing into shale, limestone and sandstone; pumped by air lift since 1917; capacity 350 gpm. Constructed in 1886 and still in service.

No. 2—Drilled well, similar to No. 1, 1,400 ft. deep, 250 ft. of 8-in. casing; pumped by air lift; capacity 500 gpm. Constructed in 1886 and still in service.

No. 3—Drilled well, similar to No. 1, 6- and 8-in. diameter, 1,685 ft. deep, 135 ft. of 8-in. casing; pumped by air lift since 1920. Constructed in 1890 and still in service.

No. 4—Drilled well, similar to No. 1, 5- and 8-in. diameter, 1,497 ft. deep, 200 ft. of 8-in. casing; artesian. Constructed in 1893 and retired in 1901 due to lowering of ground water.

No. 5—Drilled well, similar to No. 1, 8- and 12-in. diameter, 1,763 ft. deep, 850 ft. of 6-in. casing; pumped by air lift since 1922; casing replaced 1935. Constructed in 1902 and still in service.

No. 6—Drilled well, similar to No. 1, 10- and 12-in. diameter, 2,101 ft. deep, 10- and 12-in. casing; pumped by air lift since 1937. Constructed in 1910 and still in service.

No. 7—Drilled well, similar to No. 1, 12-17- and 23-in. diameter, 926 ft. of 12- and 16-in. casing; pumped by air lift. Constructed in 1937 and still in service.

Purification Works

Sedimentation Tank—Open, riveted steel tank, 30-ft. diameter by 20 ft. high; capacity 100,000 gal. Erected in 1910 and still usable.

Filters—Two riveted steel, horizontal, gravity-type filters, 8-ft. diameter by 20 ft. long; capacity 0.4 mgd. each. Erected in 1900 and still usable.

Coagulating Tanks—Two open cypress tanks, 5-ft. diameter by 5 ft. high. Erected in 1910 and still usable.

Pumping Equipment

High-Service No. 1—Gordon Maxwell horizontal, direct-acting, compound, duplex, non-condensing steam pump; rated 2-mgd. capacity. Installed in 1888 and still in service.

High-Service No. 2—Worthington, direct-acting, duplex, triple expansion, condensing steam pump; rated 4.0-mgd. capacity; 174-ft. head. Installed in 1924 and still in service.

High-Service No. 3—Holly-Gaskill, horizontal, compound, crank and flywheel, condensing steam pump, rated 5-mgd. capacity, 231-ft. head. Installed in 1892 and still in service.

Low-Service No. 4—Worthington, direct-acting, compound, duplex, non-condensing, steam pump, rated 2-mgd. capacity. Installed in 1900 and still in service.

High- and Low-Service No. 5—Worthington, direct-acting, compound, duplex, non-condensing; rated 1.0-mgd. capacity. Installed in 1893 and still in service.

High-Service No. 6—American Well Works, two-stage, horizontal centrifugal pump; rated 4.0-mgd. capacity at 280-ft. head; directly connected to Buffalo 8-cylinder gasoline engine. Installed in 1937 and still in service.

Laidlaw-Dunn, direct-acting, compound, duplex, condensing steam pump; rated 3.0-mgd. capacity; 266-ft. head. Installed in 1896; retired for scrap in 1924.

Gordon-Maxwell, steam pump, specifications unknown. Installed in 1888; retired and sold to St. Joseph Water Co. in 1893.

Two Knowles, simple, single, double-acting, non-condensing steam pumps. Installed in 1876; retired in 1900.

Compressor No. 1—Sullivan horizontal, steam-driven compressor; 614 cfm. Installed in 1917 and still in service.

Compressor No. 2—Ingersoll-Rand, horizontal steam-driven compressor; 1,042 cfm. Installed in 1922 and still in service.

Compressor No. 3—Ingersoll-Rand, vertical compressor driven by De La Vergne, 3-cylinder diesel engine; 1,302 cfm. Installed in 1931 and still in service.

TABLE 1
SUMMARY OF MAINS
CLINTON, IOWA

Size, <i>in.</i>	Kind	Total Feet	No. of Feet Installed	Percentage of Total	No of Feet Retired	Percentage of Total	No. of Feet in Service	Percentage of Total	Year of First Installation	Average Age, <i>yr.</i>
$\frac{3}{4}$	Galvanized	237	237	0.1	0	0.0	237	0.1	1909	30.5
$1\frac{1}{2}$	wrought-iron	598	598	0.3	598	2.4	0	0.0	1912	—
2	Galvanized	43,399	22,400	12.1	16,655	67.1	5,745	3.6	1890	25.8
2	steel	57,316	57,316	31.0	7,304	29.4	50,012	31.3	1912	17.1
2	Cast-iron cement lined	5,411	5,411	2.9	0	0.0	5,411	3.4	1931	2.3
3	Cast-iron unlined	300	0	0.0	0	0.0	0	0.0	—	—
4		32,542	48	0.0	0	0.0	48	0.0	1930	9.5
6		143,527	54,549	29.6	12	0.0	54,537	34.1	1876	17.0
8		57,505	11,862	6.4	0	0.0	11,862	7.4	1910	19.3
10		24,436	562	0.3	276	1.1	286	0.2	1875	16.4
12		8,928	4,266	2.3	0	0.0	4,266	2.7	1922	15.7
16		654	0	0.0	0	0.0	0	0.0	—	—
6	Cast-iron cement lined	18,445	18,445	10.0	0	0.0	18,445	11.5	1929	7.1
8	Cast-iron cement lined	8,963	8,963	5.0	0	0.0	8,963	5.6	1930	5.1
TOTAL		402,261	184,657	100.0	24,845	100.0	159,812	100.0		15.2
Percentage of Total			100.0		13.5		86.5			
Average Size, <i>in.</i>		4.9	4.5		2.1		4.9			

Mortality Survival Ratios

Size, <i>in.</i>	Kind	No. of Feet	Period Covered, <i>yr.</i>	Percentage
$\frac{3}{4}$ – $1\frac{1}{2}$	Galvanized wrought-iron	835	31.5	28.383
2	Galvanized steel	22,400	27.5	0*
2	Galvanized wrought-iron	57,316	38.5	0*
4	Cast-iron unlined	48	9.5	100.000
6		54,549	62.5	0*
8		11,862	30.5	100.000
10–12		4,828	48.5	0*
Over 12		654	64.5	100.000
6–8	Cast-iron cement lined	27,408	10.5	100.000
TOTAL		179,900		

* Due to fact that oldest pipe was retired in last year of record.

SURVIVAL AND RETIREMENT

SUMMARY OF INSTALLATIONS AND RETIREMENTS
CLINTON, IOWA

MAINS

$\frac{3}{4}$ -IN. GALVANIZED WROUGHT-IRON MAINS			
Year	Feet		
Installed	Installed	In Service	Retired
1909	237	237	0
1939	0	0	0
TOTAL	237	237	0

1 $\frac{1}{2}$ -IN. GALVANIZED WROUGHT-IRON MAINS			
Year	Feet		
Installed	Installed	In Service	Retired
1912	598	0	598
1939	0	0	0
TOTAL	598	0	598

Retirements by Years				
Year	Feet	Year	Feet	Year
Installed				
1912	200	1922	398	1939

2-IN. GALVANIZED WROUGHT-IRON MAINS			
Year	Feet		
Installed	Installed	In Service	Retired
1890	534	0	534
1892	680	0	680
1895	1,200	0	1,200
1898	827	0	827
1899	159	0	159
1902	327	0	327
1903	1,095	0	1,095
1904	270	0	270
1906	968	0	968
1907	558	0	558
1908	1,844	0	1,844
1909	4,128	679	3,449
1910	3,460	1,258	2,202
1911	3,345	1,760	1,585
1912	1,411	796	615
1913	24	0	24

Year	Feet		
Installed	Installed	In Service	Retired
1916	450	450	0
1923	318	0	318
1924	68	68	0
1927	80	80	0
1928	135	135	0
1930	380	380	0
1934	91	91	0
1935	8	8	0
1937	40	40	0
1939	0	0	0
SUBTOTAL	22,400	5,745	16,655
Unknown	20,999	18,387	2,612
TOTAL	43,399	24,132	19,267

Retirements by Years							
Year	Feet	Year	Feet	Year	Feet	Year	Feet
Installed							
1890	534	1928					
1892	400	1928	280	1929			
1895	1,200	1923					
1898	827	1926					
1899	117	1926	42	1929			
1902	285	1928	42	1929			
1903	395	1924	700	1928			
1904	270	1935					
1906	158	1922	377	1928	433	1939	
1907	150	1927	84	1928	324	1929	
1908	1,466	1923	68	1927	310	1929	
1909	127	1922	382	1923	36	1924	
	410	1925	695	1927			
1910	850	1926	593	1928	159	1932	
	600	1939					
1911	373	1922	53	1924	278	1925	
	554	1928	327	1939			
1912	48	1924	12	1926	377	1928	
	48	1929	130	1936			
1913	24	1922					
1923	318	1939					

2-IN. GALVANIZED STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	216	0	216
1913	3,032	3,032	0
1914	2,338	2,189	149
1915	4,746	3,694	1,052
1916	2,840	1,776	1,064
1917	3,432	3,313	119
1918	217	0	217
1919	380	380	0
1920	1,805	1,572	233
1921	4,322	4,182	140
1922	3,006	2,781	225
1923	4,886	3,877	1,009
1924	3,084	2,885	199
1925	5,115	4,100	1,015
1926	3,328	2,913	415
1927	3,788	3,619	169
1928	4,124	3,177	947
1929	578	578	0
1930	3,194	3,108	86
1931	1,864	1,815	49
1932	185	185	0
1933	666	666	0
1935	58	58	0
1938	112	112	0
1939	0	0	0
TOTAL	57,316	50,012	7,304

Retirements by Years

Year						
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1912	216	1939				
1914	54	1928	95	1937		
1915	504	1922	534	1926	14	1929
1916	138	1922	56	1923	136	1925
	82	1926	370	1928		
1917	61	1924	58	1939		
1918	180	1922	37	1936		
1920	127	1922	106	1926		
1921	50	1928	90	1937		
1922	120	1928	105	1939		
1923	320	1924	33	1928	108	1929
	548	1936				
1924	57	1925	142	1928		
1925	280	1927	511	1928	200	1929
	24	1930				
1926	415	1928				
1927	169	1928				
1928	141	1929	806	1932		
1930	40	1932	46	1939		
1931	49	1938				

3-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
Unknown	300	300	0
TOTAL	300	300	0

4-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	48	48	0
1939	0	0	0
SUBTOTAL	48	48	0
Unknown	32,494	31,604	890
TOTAL	32,542	31,652	890

6-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1876	12	0	12
1901	436	436	0
1909	1,538	1,538	0
1910	2,257	2,257	0
1911	463	463	0
1912	536	536	0
1913	1,414	1,414	0
1914	52	52	0
1916	60	60	0
1917	2,184	2,184	0
1920	8,229	8,229	0
1921	1,623	1,623	0
1922	2,127	2,127	0
1923	2,187	2,187	0
1924	6,213	6,213	0
1925	4,902	4,902	0
1926	4,524	4,524	0
1927	3,895	3,895	0
1928	11,897	11,897	0
1939	0	0	0
SUBTOTAL	54,549	54,537	12
Unknown	88,978	88,978	0
TOTAL	143,527	143,515	12

Retirements by Years

Year		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1876	12	1938

8-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	366	366	0
1911	895	895	0
1913	1,296	1,296	0
1916	164	164	0
1917	1,992	1,992	0
1920	660	660	0
1921	840	840	0
1923	2,172	2,172	0
1925	1,199	1,199	0
1926	666	666	0
1927	808	808	0
1928	804	804	0
1939	0	0	0
<hr/>			
SUBTOTAL	11,862	11,862	0
Unknown	45,643	45,643	0
<hr/>			
TOTAL	57,505	57,505	0

10-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1875	276	0	276
1923	276	276	0
1926	10	10	0
1939	0	0	0
<hr/>			
SUBTOTAL	562	286	276
Unknown	23,874	23,874	0
<hr/>			
TOTAL	24,436	24,160	276

Retirements by Years

Year	Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1875	276	1923

12-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1922	2,316	2,316	0
1926	1,950	1,950	0
1939	0	0	0
<hr/>			
SUBTOTAL	4,266	4,266	0
Unknown	4,662	4,662	0
<hr/>			
TOTAL	8,928	8,928	0

16-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
Unknown	654	654	0
<hr/>			
TOTAL	654	654	0

2-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	79	79	0
1932	58	58	0
1933	54	54	0
1934	494	494	0
1935	111	111	0
1936	1,026	1,026	0
1937	790	790	0
1938	641	641	0
1939	2,158	2,158	0
<hr/>			
TOTAL	5,411	5,411	0

6-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1929	2,937	2,937	0
1930	6,893	6,893	0
1932	2,412	2,412	0
1934	1,065	1,065	0
1936	2,295	2,295	0
1937	676	676	0
1939	2,167	2,167	0
<hr/>			
TOTAL	18,445	18,445	0

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	3,960	3,960	0
1931	255	255	0
1934	688	688	0
1939	4,060	4,060	0
<hr/>			
TOTAL	8,963	8,963	0

Clyde, New York

As of December 31, 1940

THE Clyde Plant of the Rochester & Lake Ontario Water Service Corporation renders water service in the village of Clyde and its environs in the town of Galen, Wayne County, located about 40 mi. east of Rochester, N.Y.

As of Dec. 31, 1940, the company furnished water to 538 customers in an area having a population of about 2,400. Sales during 1940 averaged about 0.073 mgd., or about 31 gpd. per capita.

Development of the Existing System

The Clyde Water Supply Company was incorporated in May 1888. The plant was constructed during 1888 and water service began in August 1889. In January 1928 the plant was purchased by the Federal Water Service Corporation, and, through merger, the property became the Clyde Plant of the Rochester & Lake Ontario Water Service Corporation. This corporation also furnished water service to suburban Rochester.

Originally the water supply was taken from the Clyde River. In 1891 a filter was installed but the supply continued to be unsatisfactory and was discontinued in 1902 and a new supply obtained from a shallow well. The well, brick-lined, is 13 ft. below ground level and extends 7 ft. above the ground, with dimensions 16 ft. id. by 20 ft. deep. The average yield in 1940 was 0.12 mgd.

The pumping station, located in the town of Galen, west of the corporate limits of Clyde, houses a steam-driven pump and boiler, motor-driven pump and chlorinators and auxiliary equipment. Water is chlorinated at the suction well and pumped directly into the distribution system. An open steel standpipe, 24 ft. in diameter by 60 ft. high, of 200,000-gal. capacity, furnishes storage and regulates pressures in Clyde.

At Dec. 31, 1940, there were approximately 10.5 mi. of $\frac{3}{4}$ - to 10-in. mains, 31 valves and 89 fire hydrants in service. Services numbered 538, of which 499, or 93 per cent, were metered.

Basis of Study

The records of installation and retirement of cast-iron pipe, valves, hydrants and services are stated to be complete from the inception of the original company.

Mortality Survival Study

Mortality studies were made of cast-iron mains, valves, hydrants and services. Table 1 is a summary of cast-iron mains installed, retired and remaining in service, as well as average ages and sizes, lengths of records and mortality survival ratios. Figure 1 shows the mortality survival curves covering the amounts of pipe as shown.

Tables 2, 3, and 4 are similar summaries of gate valves, hydrants and

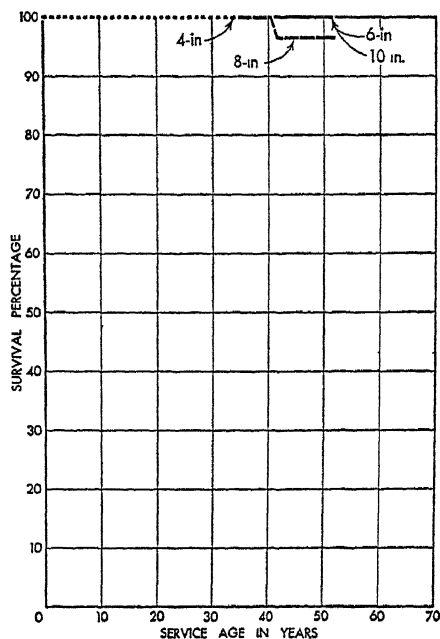


FIG. 1. Mortality Survival Curve—4-10-in. Cast-Iron Unlined Mains—Clyde, New York

BASE: Feet		SURVIVAL: 1889-1940	
SIZE in.	EXPOSURES ft.	RETIREMENTS ft.	
4	22,951	0	
6	11,533	0	
8	6,574	200	
10	1,025	0	

services. As there were no retirements of valves or hydrants the mortality survival curves are straight lines at 100 per cent and are therefore not shown. Figure 2 shows the corresponding curves for services.

Causes of Retirement

The only retirement of pipe was, as is noted in Table 1, caused by a break-age under a bridge abutment.

No classification of the causes of retirement of services could be made. In

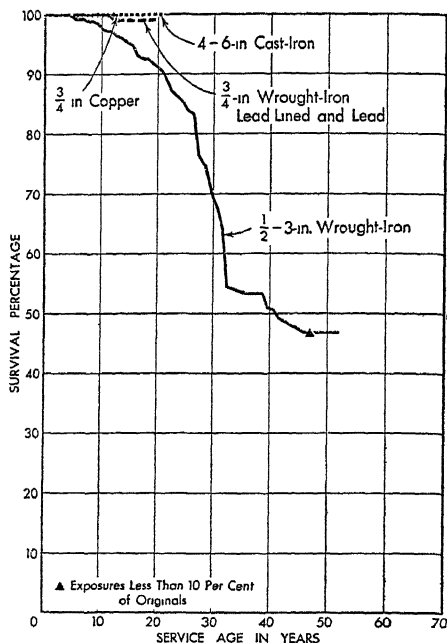


FIG. 2. Mortality Survival Curve— $\frac{1}{2}$ -6-in. Services—Clyde, New York

BASE: UNIT		SURVIVAL: 1889-1940	
SIZE in.	KIND	EXPO- SURES Units	RETIRE- MENTS Units
$\frac{1}{2}$ -3	Wrought-Iron	603	189
$\frac{3}{4}$	Wrought-Iron Lead- Lined and Lead	129	1
$\frac{3}{4}$	Copper	92	0
4	Cast-Iron	1	0
6	Cast-Iron	2	0

many cases it was noted that services were replaced in advance of permanent concrete paving.

Acknowledgment

The collection and compilation of data for the study in the Clyde Plant were under the supervision of E. L. Heyser, Chief Valuation Engineer, New York Water Service Corporation.

TABLE 1
SUMMARY OF MAINS—CLYDE, NEW YORK

Size, <i>in.</i>	Kind	No. of Feet Installed	Percent- age of Total	No. of Feet Retired	Percent- age of Total	No of Feet in Service	Percent- age of Total	Year of First In- stallation	Average Age, <i>yr.</i>
4	Cast-iron unlined	22,951	51.5	0	0	22,951	51.7	1889	33.6
6		11,533	25.9	0	0	11,533	26.0	1889	51.5
8		6,574	14.7	200*	100	6,374	14.4	1889	51.5
10	Cast-iron cement-lined	1,025	2.3	0	0	1,025	2.3	1889	51.5
6		2,271	5.1	0	0	2,271	5.1	1929	8.8
8		246	0.5	0	0	246	0.5	1930	10.5
TOTAL		44,600	100.0	200	100	44,400	100.0		39.8
Percentage of Total		100.00		0.45		99.55			
Average Size, <i>in.</i>		5.37		8.00		5.36			

Mortality Survival Ratios

Size, <i>in.</i>	Kind	No. of Feet	Period Covered, <i>yr.</i>	Percentage
4	Cast-iron unlined	22,951	51.5	100.000
6		11,533	51.5	100.000
8		6,574	51.5	96.958
10		1,025	51.5	100.000
6 and 8	Cast-iron cement-lined	2,517	11.5	100.000
TOTAL		44,600		

* Retired and abandoned in place due to break under bridge abutment.

TABLE 2
SUMMARY OF VALVES—CLYDE, NEW YORK

Size, <i>in.</i>	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, <i>yr.</i>
4	6	0	6	1889	22.8
6	15	0	15	1889	48.4
8	8	0	8	1889	48.1
10	2	0	2	1889	51.5
TOTAL	31	0	31		43.6
Percentage of Total	100.00	0	100.00		

Mortality Survival Ratios

Size, <i>in.</i>	Number Installed	Period Covered, <i>yr.</i>	Percentage
4-10	31	51.5	100.000
TOTAL	31		

SURVIVAL AND RETIREMENT

TABLE 3
SUMMARY OF HYDRANTS—CLYDE, NEW YORK

Size, in.	Kind	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, yr.
4	(2) 2½-in. nozzle	82	0	82	1889	38.3
4	(2) 2½-in. and (1) steamer nozzle	8	0	8	1889	45.5
TOTAL		90	0	90		38.9
Percentage of Total		100.00	0	100.00		

Mortality Survival Ratios

Size, in	Kind	Number Installed	Period Covered, yr.	Percentage
4	All	90	51.5	100.000
TOTAL		90		

TABLE 4
SUMMARY OF SERVICES—CLYDE, NEW YORK

Size, in.	Kind	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, yr.
1½	Wrought-iron	13	6	7	1890	49.5
2		570	179	391	1889	29.2
1		10	1	9	1897	21.2
1½		4	2	2	1890	13.0
1½		3	0	3	1894	27.2
2		2	1	1	1890	29.5
3		1	0	1	1914	26.5
2½	Wrought-iron lead-lined	10	0	10	1928	11.3
2½	Lead	119	1	118	1921	19.4
3	Copper	92	0	92	1928	6.3
4	Cast-iron	1	0	1	1929	11.5
6	Cast-iron	2	0	2	1920	16.5
TOTAL		827	190	637		23.8
Percentage of Total		100.00	22.97	77.03		

Mortality Survival Ratios

Size, in.	Kind	Number Installed	Period Covered, yr.	Percentage
1½-3	Wrought-iron	603	51.5	46.789
1½ and 2	Wrought-iron lead-lined and Lead	129	19.5	99.187
2	Copper	92	12.5	100.000
4-6	Cast-iron	3	20.5	100.000
TOTAL		827		

SUMMARY OF INSTALLATIONS AND RETIREMENTS
CLYDE, NEW YORK

MAINS

4-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	3,318	3,318	0
1895	8,112	8,112	0
1914	884	884	0
1915	1,774	1,774	0
1917	1,328	1,328	0
1921	4,367	4,367	0
1922	886	886	0
1927	2,282	2,282	0
1940	0	0	0
TOTAL	22,951	22,951	0

6-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	11,061	11,061	0
1890	472	472	0
1940	0	0	0
TOTAL	11,533	11,533	0

8-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	6,574	6,374	200
1940	0	0	0
TOTAL	6,574	6,374	200

8-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years		
Year	Feet	Year
1889	200	1930

10-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	1,025	1,025	0
1940	0	0	0
TOTAL	1,025	1,025	0

6-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1929	1,017	1,017	0
1931	496	496	0
1935	418	418	0
1937	340	340	0
1940	0	0	0
TOTAL	2,271	2,271	0

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	246	246	0
1940	0	0	0
TOTAL	246	246	0

VALVES

4-IN. VALVES

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	2	2	0
1927	2	2	0
1937	2	2	0
1940	0	0	0
TOTAL	6	6	0

6-IN. VALVES

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	13	13	0
1890	1	1	0
1935	1	1	0
1940	0	0	0
TOTAL	15	15	0

SURVIVAL AND RETIREMENT

8-IN. VALVES				10-IN. VALVES			
Year	Number			Year	Number		
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1889	7	7	0	1889	2	2	0
1916	1	1	0	1940	0	0	0
1940	0	0	0		—	—	—
TOTAL	8	8	0	TOTAL	2	2	0

HYDRANTS

4-IN. HYDRANTS—4-IN. CONNECTION, TWO HOSE NOZZLES				4-IN. HYDRANTS—4-IN. VALVE, 6-IN. CONNECTION, TWO HOSE NOZZLES			
Year	Number			Year	Number		
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1890	1	1	0	1889	34	34	0
1895	16	16	0	1895	1	1	0
1914	2	2	0	1929	3	3	0
1915	4	4	0	1935	1	1	0
1917	3	3	0	1940	0	0	0
1921	10	10	0		—	—	—
1922	2	2	0	TOTAL	39	39	0
1927	5	5	0				
1940	0	0	0				
TOTAL	43	43	0				

4-IN. HYDRANTS—TWO HOSE AND ONE STEAMER NOZZLE				4-IN. HYDRANTS—4-IN. VALVE, 6-IN. CONNECTION, TWO HOSE AND ONE STEAMER NOZZLE			
Year	Number			Year	Number		
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1895	1	1	0	1889	6	6	0
1940	0	0	0	1931	1	1	0
	—	—	—	1940	0	0	0
TOTAL	1	1	0	TOTAL	7	7	0

SERVICES

 $\frac{1}{2}$ -IN. WROUGHT-IRON SERVICES

				Retirements by Years				
Year	Number			Year				
Installed	Installed	In Service	Retired	Installed	Number	Year	Number	Year
1890	5	3	2	1890	2	1921		
1891	1	1	0	1892	2	1921	2	1923
1892	7	3	4					
1940	0	0	0					
	—	—	—					
TOTAL	13	7	6					

$\frac{3}{4}$ -IN. WROUGHT-IRON SERVICES

<i>Year</i> <i>Installed</i>	<i>Number</i>			<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	35	6	29	1912	14	13	1
1890	12	2	10	1913	35	35	0
1891	13	6	7	1914	24	21	3
1892	25	5	20	1915	15	15	0
1893	11	5	6	1916	15	12	3
1894	85	44	41	1917	13	11	2
1895	3	3	0	1918	10	9	1
1896	10	4	6	1919	5	5	0
1897	7	2	5	1920	7	7	0
1898	4	2	2	1921	40	39	1
1899	12	8	4	1922	13	13	0
1900	15	7	8	1923	18	18	0
1901	6	2	4	1924	23	20	3
1902	5	3	2	1925	8	7	1
1903	5	4	1	1926	5	5	0
1904	3	1	2	1927	11	11	0
1905	6	6	0	1928	1	1	0
1906	2	1	1	1940	0	0	0
1907	7	6	1				
1908	14	9	5	SUBTOTAL	570	391	179
1909	13	12	1	Unknown	82	0	82
1910	7	5	2				
1911	13	6	7	TOTAL	652	391	261

Retirements by Years

<i>Year</i> <i>Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year</i> <i>Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1889	1	1896	1	1913	26	1921	1901	3	1921	1	1933		
	1	1933					1902	1	1912	1	1921		
1890	1	1912	1	1913	1	1920	1903	1	1917				
	7	1921					1904	1	1911	1	1913		
1891	1	1912	5	1921	1	1933	1906	1	1921				
1892	3	1913	11	1921	1	1922	1907	1	1921				
	1	1923	3	1933	1	1937	1908	2	1921	2	1922	1	1936
1893	2	1915	3	1921	1	1933	1909	1	1923				
1894	1	1910	1	1911	4	1913	1910	1	1921	1	1922		
	27	1921	1	1922	1	1928	1911	5	1921	1	1927	1	1933
	5	1933	1	1937			1912	1	1936				
1896	1	1912	3	1921	1	1922	1914	1	1922	1	1929	1	1935
	1	1926					1916	3	1921				
1897	1	1914	3	1921	1	1924	1917	1	1933	1	1935		
1898	2	1921					1918	1	1934				
1899	4	1921					1921	1	1936				
1900	1	1913	2	1921	1	1927	1924	1	1933	1	1934	1	1936
	3	1933	1	1935			1925	1	1937				

SURVIVAL AND RETIREMENT

1-IN. WROUGHT-IRON SERVICES

Year	Number		
Installed	Installed	In Service	Retired
1897	1	1	0
1905	1	1	0
1914	1	1	0
1919	2	1	1
1920	1	1	0
1921	1	1	0
1926	1	1	0
1935	1	1	0
1937	1	1	0
1940	0	0	0
TOTAL	10	9	1

Retirements by Years

Year	Number	Year
Installed		
1919	1	1935

1½-IN. WROUGHT-IRON SERVICES

Year	Number		
Installed	Installed	In Service	Retired
1890	1	0	1
1904	1	0	1
1926	1	1	0
1929	1	1	0
1940	0	0	0
SUBTOTAL	4	2	2
Unknown	3	0	3
TOTAL	7	2	5

Retirements by Years

Year	Number	Year
Installed		
1890	1	1911
1904	1	1929

1½-IN. WROUGHT-IRON SERVICES

Year	Number		
Installed	Installed	In Service	Retired
1894	1	1	0
1913	1	1	0
1933	1	1	0
1940	0	0	0
TOTAL	3	3	0

2-IN. WROUGHT-IRON SERVICES

Year	Number		
Installed	Installed	In Service	Retired
1890	1	0	1
1911	1	1	0
1940	0	0	0
SUBTOTAL	2	1	1
Unknown	2	1	1
TOTAL	4	2	2

Retirements by Years

Year	Number	Year
Installed		
1890	1	1911

3-IN. WROUGHT-IRON SERVICES

Year	Number		
Installed	Installed	In Service	Retired
1914	1	1	0
1940	0	0	0
TOTAL	1	1	0

¾-IN. WROUGHT-IRON LEAD-LINED SERVICES

Year	Number		
Installed	Installed	In Service	Retired
1928	4	4	0
1929	1	1	0
1930	4	4	0
1931	1	1	0
1940	0	0	0
TOTAL	10	10	0

¾-IN. LEAD SERVICES

Year	Number		
Installed	Installed	In Service	Retired
1921	108	107	1
1922	11	11	0
1940	0	0	0
SUBTOTAL	119	118	1
Unknown	1	0	1
TOTAL	120	118	2

Retirements by Years

Year	Number	Year
Installed		
1921	1	1933

$\frac{1}{2}$ -IN. COPPER SERVICES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1928	2	2	0
1929	5	5	0
1930	4	4	0
1931	10	10	0
1932	1	1	0
1933	21	21	0
1934	9	9	0
1935	9	9	0
1936	10	10	0
1937	6	6	0
1938	3	3	0
1939	8	8	0
1940	4	4	0
	—	—	—
TOTAL	92	92	0

4-IN. CAST-IRON SERVICES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1929	1	1	0
1940	0	0	0
	—	—	—
TOTAL	1	1	0

6-IN. CAST-IRON SERVICES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1920	1	1	0
1928	1	1	0
1940	0	0	0
	—	—	—
TOTAL	2	2	0

Denver, Colorado

As of December 31, 1940

THE Denver Municipal Water Works, owned and operated by the municipality, serves the city of Denver and several outside districts, including Englewood, Fort Logan, Edgewater, Aurora and Fitzsimons Hospital.

Besides being the state capital, Denver is regional headquarters for numerous federal activities, and is an important commercial, distributing and financial center for the Rocky Mountain States. Industrial activity is not prominent.

As of the date of the study there were 77,122 consumers receiving service, of which only 2,568 were metered. Water delivered to the system averaged 64 mgd., serving approximately 360,000 people, or about 178 gpd. per capita.

Development of the Existing System

The oldest works of the present system were built in 1870, when the population was 4,759. Delivery of water began in 1872 from a station pumping from a well near the Platte River. The early history of water supply included considerable competition between several supply and distributing companies. The Denver City Water Co. (1870) and the Denver City Irrigation and Water Co. (1878) combined to form the Denver Water Co. (1882) and in 1890 this company took over the Domestic Water Co., which had been formed in 1886. In the meantime two other companies, the Beaver Brook

Water Co. (1886) and the Mountain Water Co. (1888), were formed and consolidated with the Denver Water Co. to form the Denver City Water Works Co. (1890), which was purchased by the American Water Works Co. of New Jersey in 1891.

In 1889 an independent local company, the Citizens Water Co., was formed. It continued in competition with the American Water Works Co until 1894, when the two companies consolidated to form the Denver Union Water Co. The South Platte Canal and Reservoir Co. was organized in 1894 to build the Cheesman Dam, which was, upon completion, leased to the Denver Union Water Co.

In 1918 the existing water works systems were purchased by the city and since then have been owned and operated by the city through a board of water commissioners.

The early history of the formation of the existing system is important in this study, since it produced several competing systems within the same service areas having duplicating pipelines and other facilities. In 1896, the first steps were taken to eliminate duplicate pipes and between that date and 1914 a considerable portion of the duplicate distribution mains were either taken up or abandoned.

The sources of the supply for Denver have been developed over the years, with the South Platte River system located south of the city and the Fraser

River system, west of the Continental Divide, forming two independent major sources.

The South Platte system secures its supply largely from the South Platte River at Intake. Subsidiary sources

are located on the tributaries, Bear and Cherry Creeks. Antero (1910), Platte Cañon (1904) and Eleven Mile Cañon (1932) reservoirs, Lake Cheesman (1904) and Marston Lake (1898) provide storage on this watershed. Lake

TABLE 1
SUMMARY OF MAINS
DENVER, COLORADO

Size, in.	Kind	No of Feet Installed	Percent- age of Total	No. of Feet Retired	Percent- age of Total	No of Feet in Service	Percent- age of Total	Year of First Instal- lation	Average Age, yr.
48	Cast-iron	250	0.0	0	0.0	250	0.0	1925	12.8
46	Concrete	6,968	0.1	0	0.0	6,968	0.1	1940	0.5
42	Cast-iron	143	0.0	0	0.0	143	0.0	1924	15.0
42	Concrete	3,169	0.1	0	0.0	3,169	0.1	1940	0.5
41.34	Cast-iron	2,483	0.0	0	0.0	2,483	0.0	1924	16.5
39.37		2,286	0.0	0	0.0	2,286	0.0	1924	16.5
36		14,601	0.3	0	0.0	14,601	0.3	1924	15.4
30		54,494	1.1	434	0.0	54,060	1.3	1888	20.1
30		2,513	0.1	2,513	0.3	0	0.0	1888	—
30	Wood-stave	16,862	0.3	0	0.0	16,862	0.4	1938	2.3
30	Concrete	2,533	0.1	0	0.0	2,533	0.1	1928	12.5
30	Steel	121,032	2.3	4,523	0.5	116,509	2.8	1890	30.2
24	Cast-iron	6,552	0.1	6,552	0.7	0	0.0	1889	—
24	Wood-stave	2,763	0.1	0	0.0	2,763	0.1	1911	27.8
24	Steel	47,381	0.9	12,137	1.2	35,244	0.8	1880	24.4
20	Cast-iron	26,511	0.5	354	0.0	26,157	0.6	1888	39.1
18		111,498	2.2	9,797	1.0	101,701	2.5	1888	34.5
16		6,177	0.1	0	0.0	6,177	0.1	1872	68.5
15		34,840	0.7	892	0.1	33,948	0.8	1888	50.0
14		695,650	13.5	61,203	6.0	634,447	15.3	1881	28.0
12		109,953	2.1	18,267	1.8	91,686	2.2	1881	46.5
10		394,076	7.6	27,339	2.7	366,737	8.8	1881	28.5
8		1,915,355	37.1	276,424	27.2	1,638,931	39.5	1878	36.4
6		619,711	12.0	248,064	24.4	371,647	9.0	1878	49.7
4		389,159	7.5	79,363	7.8	309,796	7.5	1881	11.0
3	Cast-iron, Galva- nized- iron								
2½	Galvanized- iron	1,090	0.0	275	0.0	815	0.0	1907½	33.5
2		526,585	10.2	239,524	23.6	287,061	6.9	1884	20.6
1½		24,046	0.5	15,072	1.5	8,974	0.2	1890	31.3
1½		13,864	0.3	8,406	0.8	5,458	0.1	1890	32.7
1		10,012	0.2	3,997	0.4	6,015	0.1	1895	31.7
TOTAL		5,162,557	100.0	1,015,136	100.0	4,147,421	100.0		32.1
Percentage of Total		100.0		19.7		80.3			
Average Size, in.		7.60		5.23		8.18			

TABLE 1 (contd.)
Mortality Survival Ratios

Size, in.	Kind	No. of Feet	Period Covered, yr.	Percentage
1-1½	Galvanized-iron	47,922	45.5	32.894
2-3	Cast-iron,	916,834	58.5	0.000
	Galvanized-iron			
4	Cast-iron	619,711	62.5	59.142
6		1,915,355	62.5	82.943
8		394,076	59.5	88.908
10 and 12		805,603	59.5	87.455
Over 12		421,696	68.5	86.507
SUBTOTAL		5,121,197		
Other Kinds		41,360		
TOTAL		5,162,557		

TABLE 2
SUMMARY OF CONDUITS
DENVER, COLORADO

Size, in.	Kind	No. of Feet Installed	No. of Feet Retired	No. of Feet in Service	Year of First Installation	Average Age, yr.
84	Concrete	619	0	619	1925	15.5
72	Concrete Tunnel	66	0	66	1911	29.5
66	Concrete	31,471	0	31,471	1925	15.5
66	Steel	4,873	0	4,873	1925	12.6
66	Wood-stave	65,024	12,597	52,427	1925	12.8
63	Steel	17,563	0	17,563	1938	2.5
60	Cast-iron	67	0	67	1911	29.5
60	Concrete	57,722	0	57,722	1930	10.5
60	Steel	1,179	0	1,179	1911	28.7
60	Wood-stave	13,083	714	12,369	1911	28.5
57	Steel	12,581	0	12,581	1938	2.5
54	Concrete	69,915	662	69,253	1921	13.4
54	Steel	8,936	0	8,936	1925	15.5
51	Steel	6,344	0	6,344	1938	2.5
48	Cast-iron	2,222	1,743	479	1910	24.6
48	Steel	8,784	3,345	5,439	1910	15.5
48	Wood-stave	152,207	99,676	52,531	1884	28.6
44	Wood-stave	8,517	7,346	1,171	1893	47.5
42	Cast-iron	541	0	541	1899	36.6
42	Concrete	20,550	0	20,550	1938	2.5
42	Steel	45,613	0	45,613	1938	2.5
40	Wood-stave	114,256	110,819	3,437	1884	9.5
38	Concrete Tunnel	12,336	7,722	4,614	1893	47.5
36	Cast-iron	36,228	1,496	34,732	1884	18.0
36	Concrete	2,892	0	2,892	1907	29.0
36	Steel	244	0	244	1938	2.5
36	Wood-stave	11,250	7,306	3,944	1899	29.8

TABLE 2 (contd.)

Size, in.	Kind	No. of Feet Installed	No. of Feet Retired	No. of Feet in Service	Year of First Installation	Average Age, yr.
34	Steel	4,162	0	4,162	1893	23.1
34	Wood-stave	96,076	51,534	44,542	1893	43.3
30	Cast-iron	22,530	1,134	21,396	1890	46.8
30	Concrete	26,303	0	26,303	1939	1.5
30	Steel	3,567	2,936	631	1929	2.5
30	Wood-stave	161,465	134,517	26,948	1890	29.2
16	Cast-iron	1,941	0	1,941	1939	1.5
16	Steel	300	0	300	1933	7.5
TOTAL		1,021,427	443,547	577,880		16.9
Percentage of Total		100.0	43.4	56.6		
Average Size, in.		43.8	38.5	49.6		

*Mortality Survival Ratios **

Size, in.	Kind	No. of Feet	Period Covered, yr.	Percentage
16-60	Cast-iron	63,529	51.5	84.414
30-84	Concrete	236,471	33.5	99.205
16-66	Steel	119,442	47.5	37.459
24-66	Wood-stave	630,948	56.5	9.526
TOTAL		1,050,390		

* Including distribution mains other than cast-iron. Concrete-lined tunnel not included.

Cheesman and Eleven Mile Cañon reservoirs each impound about 26 bil. gal.

The intake (1912) on the South Platte receives the flow from Lake Cheesman and Eleven Mile Cañon Reservoir and diverts it through a conduit to the Platte Cañon Reservoir and Marston Lake. Harriman and Soda lakes, supplied from Bear Creek, are auxiliary to Marston Lake. The supply from Cherry Creek (1888) is independently secured from an infiltration gallery and is serviced directly to the city.

The supply from the South Platte system is purified at Waterton by the Kassler slow sand filters, of 30-mgd.

capacity (1903), located near Platte Cañon Reservoir and in the South Side Marston filter plant (1894), capacity 21 mgd., and the North Side plant (1925), capacity 64 mgd., both rapid sand filtration plants.

The Transmountain Water Diversion, or Fraser River system, first projected in 1914, was initially placed in service, through the completion of the Moffat Tunnel, in 1938. The diversion of the Vasquez, Buck and Jim creeks and the Fraser River provides the supply through the Moffat Tunnel, which is 6.3 mi. in length with an inside diameter of 10.5 ft. From the Moffat Tunnel the water flows down South Boulder Creek to an intake where it is

TABLE 3
SUMMARY OF VALVES
DENVER, COLORADO

Size, in.	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, yr.
48	4	0	4	1925	11.5
42	4	1	3	1924	5.8
36	22	0	22	1924	13.4
30	45	1	44	1888	16.9
24	150	7	143	1890	24.3
20	48	5	43	1881	24.5
18	42	1	41	1890	37.8
16	150	10	140	1890	33.0
15	8	0	8	1872	57.3
14	74	9	65	1890	45.9
12	1,820	86	1,734	1883	24.6
10	263	24	239	1890	39.0
8	1,311	47	1,264	1883	23.7
6	5,475	379	5,096	1880	33.1
4	943	277	666	1881	37.5
3	783	161	622	1881	10.4
2½	3	1	2	1907	17.5
2	1,129	518	611	1890	17.9
1½	60	23	37	1892	24.6
1¼	34	16	18	1890	24.3
1	30	11	19	1895	29.1
TOTAL	12,398	1,577	10,821		28.7
Percentage of of Total	100.0	12.7	87.3		

Mortality Survival Ratios

Size, in.	Number	Period Covered, yr.	Percentage
1-1½	124	45.5	42.245
2-3	1,915	58.5	0
4	943	52.5	60.102
6	5,475	60.5	83.265
8	1,311	57.5	89.290
10 and 12	2,083	57.5	91.227
Over 12	547	68.5	68.298
TOTAL	12,398		

diverted to Ralston Creek Reservoir and thence through a conduit to the Moffat filter plant, a recently built rapid sand plant of 56-mgd. capacity.

A system of conduits from the filter plants carries the filtered water to the city, where there are located three distribution reservoirs, the 35-mil.gal.

TABLE 4
SUMMARY OF HYDRANTS, HYDRANT VALVES AND LATERALS
DENVER, COLORADO

Size, in.	Number Identified	Number Retired	Number in Service	Year of First Installation	Average Age, yr.	Mortality Survival Ratio, %
<i>Hydrants, each</i>						
4	612	243	369	1885	41.5	51.622
6	4,298	132	4,166	1889	34.9	94.676
TOTAL	4,910	375	4,535		35.4	
Percentage of Total	100.0	7.64	92.36			
<i>Hydrant Laterals, ft. pipe</i>						
4 (Cast-iron)	6,633	2,185	4,448	1889	43.8	61.117
6 (Cast-iron)	53,300	2,369	50,931	1889	35.4	93.114
TOTAL	59,933	4,554	55,379		36.0	
Percentage of Total	100.0	7.60	92.40			
<i>Hydrant Valves, each</i>						
4	498	177	321	1889	36.6	49.256
6	4,487	194	4,293		32.6	91.847
TOTAL	4,985	371	4,614		32.9	
Percentage of Total	100.0	7.44	92.56			

TABLE 5
SUMMARY OF LEAD SERVICES
DENVER, COLORADO

Size, in.	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, yr.
$\frac{1}{2}$	5,121	921	4,200	1875	49.7
$\frac{5}{8}$	33,661	1,739	31,922	1875	36.7
$\frac{3}{4}$	33,821	1,027	32,794	1875	19.1
1	2,164	135	2,029	1875	32.0
$1\frac{1}{4}$	312	12	300	1887	22.5
$1\frac{1}{2}$	480	28	452	1888	35.7
2	144	10	134	1881	34.7
3	26	4	22	1900	16.0
TOTAL	75,729	3,876	71,853		29.2
Percentage of Total	100.0	5.1	94.9		

TABLE 5 (contd.)
Mortality Survival Ratios

Size, in.	Number	Period Covered, yr.	Percentage
$\frac{1}{2}$	5,121	65.5	81.284
$\frac{5}{8}$	33,661	65.5	89.314
$\frac{3}{4}$	33,821	65.5	82.250
1-3	3,126	65.5	88.600
TOTAL	75,729		

Capital Hill Reservoir (1888 and 1907), the 41-mil.gal. Ashland Avenue Reservoir (1891) and the 5-mil.gal. Montclair Reservoir. Pumping stations with electrical equipment at each of these points serve the higher districts, while the business section and the lower portions along the Platte River receive their supply by gravity from the South Platte system.

The transmission or conduit system consists of approximately 115 mi. of cast-iron, wood stave, steel and concrete pipe from 16 to 84 in. in diameter. In the distribution system there are approximately 13 mi. of 1- to 48-in. diameter pipe outside the city and 777 mi. within the city. Except for the smaller galvanized-iron mains, the pipe system consists almost entirely of Class B tar-coated cast-iron pipe laid with a cover of $4\frac{1}{2}$ ft. There are over 15,400 valves and 4,500 hydrants in the system. The 77,000 services are almost entirely of lead.

Basis of Study

The records of the system pertaining to distribution and transmission mains, valves, hydrants and services are substantially complete from the original date of construction or installation. The early wood distribution mains are not included in this study.

Record drawings of the pipe system, with card index records of valves and hydrants, are available. The city has a complete record of service installations and retirements. No attempt was made to compile the record of Class B facilities, or of the few meters in the system.

Mortality Survival Study

Mortality survival studies of the transmission and distribution pipe, valves, hydrants and hydrant laterals and services were made. Table 1 is a summary of all the distribution pipe installed and retired and data relating to the average ages of the surviving pipe, length of record, average sizes and mortality survival ratios. Table 2 is a similar table pertaining to the conduits. Figures 1, 2 and 3 show the mortality survival curves for the facilities covered by the respective tables.

While generally in these studies the mortality survival curves have been based upon the mortality effects of the entire retirement history of the facilities studied, in the case of Denver there have been drawn on Fig. 1 the mortality survival curves for 4- and 6-in. pipe, based on the retirements which have taken place in the 20-year period from 1920 to 1940. The reason for the very great difference in the respec-

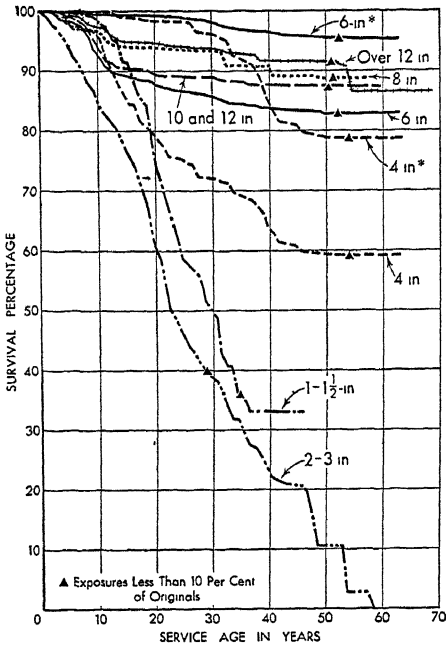


FIG. 1. Mortality Survival Curve—1-48-in. Mains—Denver, Colorado

BASE: Feet SURVIVAL: 1872-1940
1920-1940

SIZE in.	KIND	EXPO- SURES ft.	RETIRE- MENTS ft.
1-1½	Galvanized-Iron	47,922	27,475
2-3		916,834	319,162
4*		466,174	94,527
4		619,711	248,064
6*		1,690,190	51,259
6	Cast-Iron	1,915,355	276,424
8		394,076	27,339
10 and 12		805,603	79,470
Over 12		421,696	28,137

* Retired 1920-1940.

tive curves is due almost entirely to the retirement, either by the removal or the abandonment of the pipe, of some of the duplicate mains arising from the competing systems serving the territory in its early history.

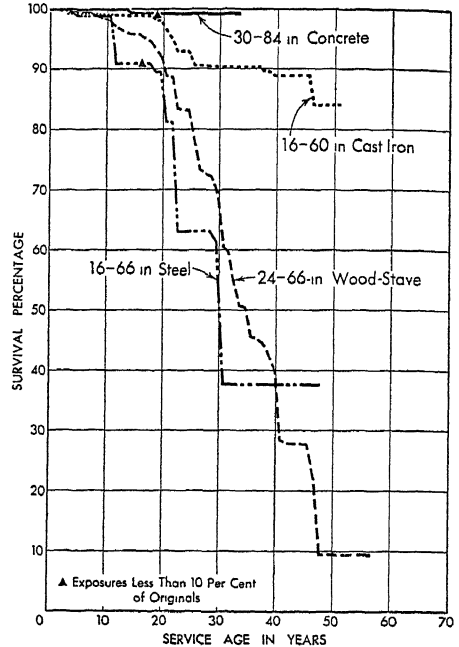


FIG. 2. Mortality Survival Curve—16-84-in. Transmission Mains—Denver, Colorado

BASE: Feet SURVIVAL: 1884-1940

SIZE in.	KIND	EXPO- SURES ft.	RETIRE- MENTS ft.
16-60	Cast-Iron	63,529	4,373
24-66	Wood-Stave	630,948	433,574
30-84	Concrete	236,471	662
16-66	Steel	119,442	6,281

Table 3 is a summary of the distribution valves and appurtenant data and Fig. 3 shows the corresponding mortality survival curves.

Table 4 and Fig. 4 give the similar data applicable to hydrants and hydrant laterals and valves.

Table 5 and Fig. 5 show similar studies of the lead services.

The basic data covering the installations and retirements are appended hereto.

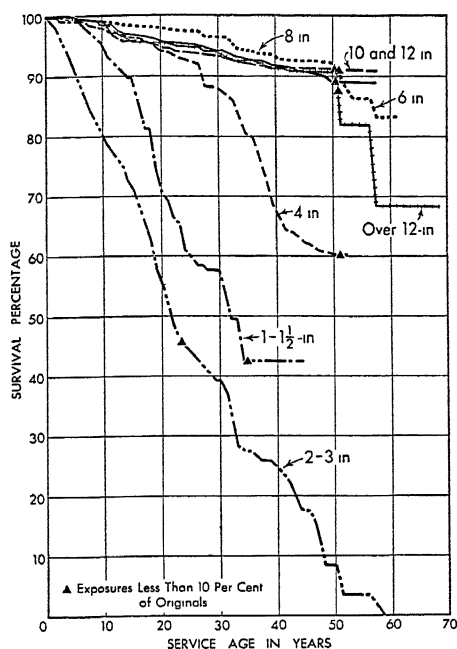


FIG. 3. Mortality Survival Curve—1-48-in. Gate Valves—Denver, Colorado

BASE: Unit	SURVIVAL: 1872-1940	
SIZE in.	EXPOSURES Units	RETIREMENTS Units
1-1½	124	50
2-3	1,915	680
4	943	277
6	5,475	379
8	1,311	47
10 and 12	2,083	110
Over 12	547	34

Causes of Retirements

The records of the department indicate substantially the number of cast-iron pipe units which have been taken out and those which have been abandoned since the inception of the system. A similar division of retirements is available for gate valves. Table 6

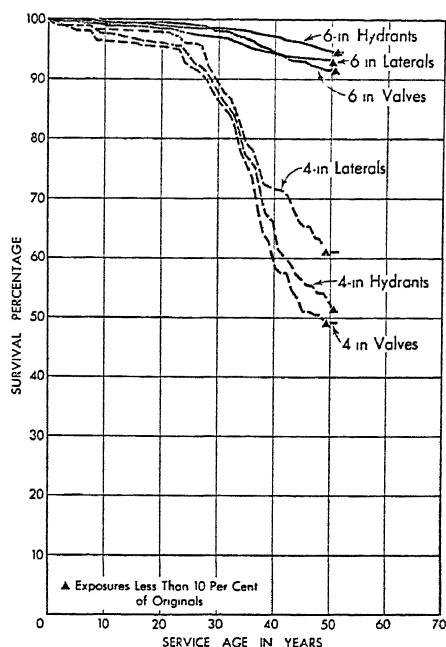


FIG. 4. Mortality Survival Curve—4-6-in. Hydrants and Appurtenances—Denver, Colorado

BASE: Unit	SURVIVAL: 1889-1940	
SIZE in.	EXPOSURES Units	RETIREMENTS Units
Valves	4 498	177
	6 4,487	194
Laterals	4 6,633	2,185
	6 53,300	2,369
Hydrants	4 612	243
	6 4,298	132

shows the footage of cast-iron pipe identifiable as to whether it was taken out or abandoned, divided into two periods, from the beginning to 1914 and from 1914 to 1940. The first period covers the time when duplicating mains were actively being eliminated. It is estimated by department officials that, in their tenure of office,

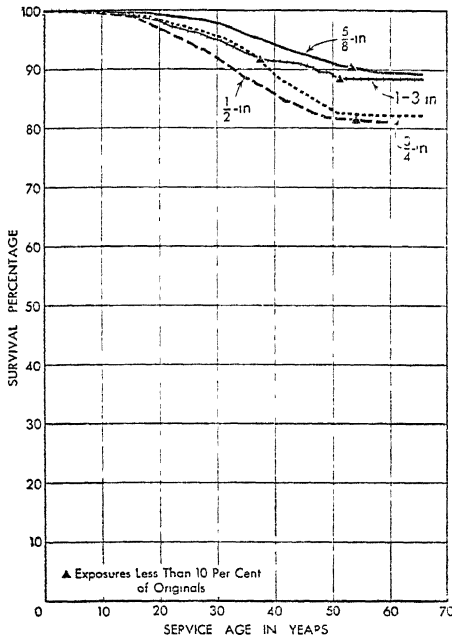


FIG. 5. Mortality Survival Curve— $\frac{1}{2}$ -3-in. Lead Services—Denver, Colorado

BASE: Unit SURVIVAL: 1875-1940

SIZE <i>in.</i>	EXPOSURES <i>Units</i>	RETIREMENTS <i>Units</i>
$\frac{1}{2}$	5,121	921
$\frac{3}{8}$	33,661	1,739
$\frac{3}{4}$	33,821	1,027
1-3	3,126	189

Table 7 gives the proportions of gate valves identified as abandoned or taken out in the period from 1914 to 1940.

Acknowledgments

The collection and compilation of data pertaining to the study in Denver were made possible through the efforts of George F. Hughes, Executive Secretary and a member of the Committee on Survival and Retirement Experience With Water Works Facilities. The work of abstracting the records of installation and retirement of the facilities studied was carried out by the regular staff of the department, under the general direction of D. D. Gross, Chief Engineer, and John Burgess, Engineer.

TABLE 7

SUMMARY OF IDENTIFIED VALVES
TAKEN OUT OR ABANDONED, 1914 TO 1940
DENVER, COLORADO

Size, <i>in.</i>	Number Taken Out	Number Abandoned	Percentage Abandoned
4	101	126	55.5
6	174*	47	21.3
8	28	5	15.2
10	14	0	0
12	27	0	0
14	3	0	0
18	1	0	0
20	3	1	25.0
24	5	0	0
30	1	0	0
42	1	0	0
TOTAL	358	179	33.3

* Includes one 6-in. valve sold.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
DENVER, COLORADO

MAINS

1-IN. GALVANIZED-IRON MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1895	655	466	189
1901	817	92	725
1902	600	600	0
1904	1,473	242	1,231
1905	325	0	325
1906	288	288	0
1907	1,097	650	447
1908	1,014	1,014	0
1909	697	328	369
1910	892	806	86
1911	709	405	304
1912	225	225	0
1913	140	0	140
1914	144	144	0
1917	469	288	181
1923	35	35	0
1924	48	48	0
1929	124	124	0
1931	250	250	0
1938	3	3	0
1939	7	7	0
1940	0	0	0
TOTAL	10,012	6,015	3,997

1½-IN. GALVANIZED-IRON MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1890	680	0	680
1898	465	465	0
1903	1,385	1,015	370
1904	2,967	387	2,580
1905	595	0	595
1906	1,801	274	1,527
1907	1,419	886	533
1908	1,602	1,038	564
1909	566	0	566
1911	361	361	0
1914	136	136	0
1915	110	110	0
1917	413	96	317
1918	440	440	0
1919	173	173	0
1923	81	7	74
1926	606	6	600
1927	5	5	0
1933	39	39	0
1936	20	20	0
1940	0	0	0
TOTAL	13,864	5,458	8,406

Retirements by Years

<i>Year</i>	<i>Retirements by Years</i>					
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1895	189	1926				
1901	425	1926	300	1927		
1904	500	1925	30	1926	58	1927
	300	1931	343	1938		
1905	325	1939				
1907	227	1924	140	1931	80	1935
1909	168	1925	201	1935		
1910	86	1929				
1911	304	1928				
1913	140	1923				
1917	181	1927				

Retirements by Years

<i>Year</i>	<i>Retirements by Years</i>					
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1890	680	1922				
1903	370	1931				
1904	1,850	1923	730	1926		
1905	350	1923	245	1928		
1906	155	1925	330	1926	372	1928
	400	1930	270	1936		
1907	203	1923	330	1931		
1908	564	1936				
1909	229	1925	144	1930	193	1940
1917	29	1924	288	1931		
1923	74	1930				
1926	600	1938				

SURVIVAL AND RETIREMENT

2-IN. GALVANIZED-IRON MAINS (contd.)

Year				Year			
		Feet				Feet	
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1911	33,798	15,792	18,006	1927	5,642	4,996	646
1912	13,694	5,132	8,562	1928	3,092	2,353	739
1913	7,277	604	6,673	1929	3,180	2,363	817
1914	1,522	0	1,522	1930	796	712	84
1915	2,084	0	2,084	1931	546	531	15
1916	909	0	909	1932	1,980	1,929	51
1917	7,185	2,295	4,890	1933	681	681	0
1918	1,291	891	400	1934	369	369	0
1919	5,130	2,641	2,489	1935	913	878	35
1920	23,011	12,909	10,102	1936	674	674	0
1921	46,492	25,669	20,823	1937	1,313	1,313	0
1922	80,980	49,419	31,561	1938	788	692	96
1923	55,770	32,479	23,291	1939	404	353	51
1924	33,495	23,056	10,439	1940	447	447	0
1925	37,417	30,455	6,962				
1926	23,801	19,947	3,854				
				TOTAL	526,585	287,061	239,524

Retirements by Years

Year				Year			
		Feet				Feet	
Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1884	335	1899					
1892	721	1923	873	1924	287	1928	
	42	1933					
1893	539	1935	565	1936	539	1937	
1894	650	1923	203	1931			
1896	407	1927	412	1929			
1897	548	1913	2,140	1923	1,246	1924	
	337	1939					
1898	600	1911	156	1938			
1899	846	1928					
1901	240	1924	255	1927			
1902	1,704	1913	209	1924	397	1930	
1903	1,211	1924					
1904	2,626	1923	460	1924	220	1925	
	1,063	1927	1,762	1931	670	1933	
	199	1937	499	1940			
1905	2,892	1924	1,271	1925	887	1928	
	590	1929	270	1930	175	1932	
	457	1933	316	1940			
1906	587	1923	4,245	1924	26	1925	
	28	1927	575	1928	647	1929	
	1,064	1930	152	1931	81	1933	
	185	1937	465	1938	330	1939	
1907	650	1922	612	1923	41	1925	
	271	1928	22	1929	941	1931	
	1,552	1932	600	1938	150	1939	
1908	925	1924	625	1927	625	1928	
	845	1929	2,653	1930	2,259	1931	
	654	1936	1,808	1940			
1909	704	1923	2,594	1924	1,139	1925	
	889	1926	707	1927	3,909	1928	
	1,205	1929	1,662	1930	2,783	1931	
	617	1933	862	1939			
		Feet				Feet	
Installed	Feet	Year	Feet	Year	Installed	Feet	Year
1910	2,139	1923	4,248	1924	1,573	1925	
	117	1926	1,104	1927	971	1928	
	1,472	1929	443	1930	359	1931	
	277	1932	344	1933	585	1935	
	283	1939					
1911	575	1923	2,255	1924	364	1925	
	1,843	1926	3,425	1927	3,023	1928	
	948	1930	2,625	1931	31	1932	
	253	1933	590	1935	732	1938	
	537	1939	805	1940			
1912	1,105	1923	1,861	1924	911	1926	
	882	1927	1,048	1930	1,527	1931	
	140	1932	696	1935	392	1937	
1913	229	1923	3,011	1924	187	1927	
	530	1928	1,472	1930	1,244	1931	
1914	244	1920	409	1931	603	1936	
	266	1940					
1915	935	1926	278	1930	871	1940	
1916	335	1926	287	1927	287	1931	
1917	2,125	1924	698	1928	2,067	1931	
1918	400	1931					
1919	360	1924	23	1925	360	1926	
	1,278	1928	412	1931	56	1934	
1920	1,093	1925	335	1926	925	1927	
	1,936	1928	2,710	1929	407	1930	
	968	1931	720	1932	694	1937	
	314	1940					
1921	410	1923	1,406	1925	967	1926	
	1,926	1927	3,562	1928	1,527	1929	
	668	1930	5,736	1931	83	1932	
	83	1933	2,302	1939	2,153	1940	
1922	1,194	1923	982	1924	2,936	1925	
	1,170	1926	5,444	1927	2,473	1928	

2-IN. GALVANIZED-IRON MAINS (contd.)

Retirements by Years (contd.)

Year						Year					
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year
	1,397	1929	2,519	1930	6,590	1931	1926	448	1929	249	1930
	1,987	1932	377	1935	328	1937		54	1932	129	1933
	178	1938	3,772	1939	214	1940		143	1937	1,671	1940
1923	561	1923	1,912	1925	1,812	1927	1927	26	1928	54	1930
	5,789	1928	733	1929	1,334	1930		97	1932	135	1940
	3,830	1931	627	1932	630	1933	1928	79	1929	452	1931
	78	1937	2,332	1939	3,763	1940		102	1938		106
1924	351	1926	1,077	1927	1,099	1928	1929	68	1930	749	1939
	1,495	1929	225	1930	3,344	1931	1930	84	1940		
	713	1932	60	1933	209	1937	1931	15	1937		
	682	1938	707	1939	477	1940	1932	51	1938		
1925	182	1925	133	1926	682	1927	1935	35	1937		
	349	1928	1,412	1929	119	1930	1938	96	1939		
	1,514	1931	500	1932	542	1933	1939	51	1939		
	27	1934	543	1937	606	1938					
	90	1939	263	1940							

2½-IN. GALVANIZED-IRON MAINS

Year				Retirements by Years		
Installed	Installed	In Service	Retired	Year	Feet	Year
1907	815	815	0	1911	275	1924
1911	275	0	275			
1940	0	0	0			
TOTAL	1,090	815	275			

3-IN. CAST-IRON AND GALVANIZED-IRON MAINS

Year				Year			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1881	23,119	0	23,119	1927	26,941	23,595	3,346
1883	2,470	0	2,470	1928	40,920	36,439	4,481
1888	49	0	49	1929	19,789	17,254	2,535
1890	110	0	110	1930	16,474	14,021	2,453
1891	679	0	679	1931	9,161	7,740	1,421
1892	4,219	0	4,219	1932	10,030	9,544	486
1897	410	0	410	1933	5,965	5,840	125
1912	660	660	0	1934	4,026	3,899	127
1917	440	404	36	1935	11,216	10,188	1,028
1920	1,135	0	1,135	1936	14,040	11,507	2,533
1921	2,646	2,612	34	1937	16,988	16,841	147
1922	10,834	8,256	2,578	1938	12,423	11,946	477
1923	28,616	20,651	7,965	1939	13,808	13,723	85
1924	42,735	35,884	6,851	1940	15,021	14,918	103
1925	35,196	28,492	6,704				
1926	19,039	15,382	3,657	TOTAL	389,159	309,796	79,363

SURVIVAL AND RETIREMENT

3-IN. CAST-IRON AND GALVANIZED-IRON MAINS (contd.)

Retirements by Years

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1881	2,642	1891	1,480	1893	835	1895			1925	2,094	1940			
	480	1896	655	1899	1,220	1901			1926	177	1927	82	1928	263
	5,470	1902	680	1903	1,017	1905				995	1931	1,645	1932	171
	500	1906	500	1912	257	1913				10	1939	314	1940	
	1,683	1916	482	1927	1,350	1928			1927	117	1927	183	1928	767
	1,968	1929	1,375	1934	57	1938				1,636	1931	223	1932	76
	468	1939								168	1936	176	1937	
1883	450	1895	1,120	1902	900	1906			1928	67	1929	557	1930	1,084
1888	49	1890								1,283	1932	403	1935	233
1890	100	1902	10	1916						587	1938	202	1939	65
1891	679	1924							1929	253	1930	122	1931	303
1892	2,600	1904	1,297	1906	322	1924				602	1937	1,255	1940	
1897	410	1924							1930	17	1930	1,327	1932	125
1917	36	1931								118	1937	206	1938	122
1920	1,135	1925								538	1940			
1921	34	1930							1931	46	1931	81	1933	58
1922	20	1925	663	1927	371	1928				359	1937	237	1938	640
	130	1929	1,394	1932					1932	431	1935	55	1938	
1923	2,120	1925	230	1926	1,255	1927			1933	125	1939			
	1,858	1928	937	1931	1,525	1932			1934	127	1937			
	26	1939	14	1940					1935	236	1936	515	1937	42
1924	943	1925	226	1926	831	1928				80	1939	155	1940	
	204	1930	2,141	1931	877	1932			1936	2,037	1937	496	1940	
	80	1933	1,549	1938					1937	147	1937			
1925	30	1925	135	1926	2,521	1927			1938	160	1939	317	1940	
	27	1928	9	1929	839	1931			1939	85	1939			
	162	1933	700	1937	187	1939			1940	103	1940			

4-IN. CAST-IRON UNLINED MAINS

<i>Year Installed</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1878	1,996	1,996	0	1899	8,685	2,797	5,888
1881	12,356	2,505	9,851	1900	2,168	2,138	30
1883	6,777	2,300	4,477	1901	13,190	10,886	2,304
1884	2,369	1,375	994	1902	7,577	5,696	1,881
1885	3,923	920	3,003	1903	643	643	0
1886	13,085	3,918	9,167	1904	4,986	0	4,986
1887	96,867	96,867	0	1905	656	656	0
1888	76,032	25,804	50,228	1906	5,572	657	4,915
1889	72,510	53,632	18,878	1907	3,009	2,274	735
1890	44,034	6,058	37,976	1909	2,597	24	2,573
1891	149,194	119,838	29,356	1910	553	0	553
1892	33,793	0	33,793	1911	2,721	0	2,721
1893	26,637	20,344	6,293	1913	426	426	0
1894	6,694	0	6,694	1914	137	115	22
1895	1,080	180	900	1915	36	0	36
1896	7,834	122	7,712	1916	53	17	36
1897	2,181	352	1,829	1917	27	0	27
1898	1,863	1,863	0	1918	4	4	0

4-IN. CAST-IRON UNLINED MAINS (contd.)

Feet				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1919	367	340	27	1930	256	256	0
1920	35	35	0	1931	64	64	0
1921	2,517	2,517	0	1932	9	9	0
1922	328	328	0	1934	177	177	0
1923	470	470	0	1936	62	62	0
1924	422	422	0	1937	117	117	0
1925	52	52	0	1938	67	67	0
1926	943	943	0	1940	92	92	0
1927	258	79	179				
1928	979	979	0	TOTAL	619,711	371,647	248,064
1929	231	231	0				

Retirements by Years

Year						Year					
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year
1881	80	1890	244	1891	500	1899	1892	1,672	1895	920	1898
	5,920	1902	2,600	1903	25	1906		400	1902	4,912	1904
	482	1927						799	1906	4,391	1907
1883	81	1891	550	1902	2,480	1903		1,866	1917	827	1923
	450	1906	916	1926				5,929	1930		
1884	446	1902	548	1907			1893	346	1895	18	1924
1885	135	1891	773	1895	480	1902		345	1931	2,160	1932
	1,415	1905	200	1909				617	1938	719	1940
1886	48	1890	95	1891	1,124	1895	1894	1,302	1922	50	1925
	500	1901	500	1902	6,900	1903		313	1930	4,377	1939
1888	1,902	1890	767	1891	1,634	1895	1895	220	1904	680	1928
	1,832	1896	3,078	1898	12,234	1899	1896	655	1907	426	1926
	2,905	1900	6,269	1901	4,441	1902		4,588	1929	643	1939
	7,027	1903	845	1905	3,109	1906	1897	1,303	1924	526	1939
	2,126	1915	532	1925	732	1926	1899	3,915	1906	885	1912
	795	1928						100	1938		
1889	150	1890	863	1895	1,080	1899	1900	30	1927		
	440	1900	1,660	1901	2,074	1902	1901	424	1912	875	1926
	2,905	1903	565	1905	198	1906	1902	1,285	1916	29	1925
	1,378	1909	325	1910	688	1911	1904	20	1923	9	1924
	410	1922	4,806	1928	1,280	1930		4,499	1931		
	56	1934					1906	665	1916	1,321	1924
1890	950	1895	260	1896	346	1898		2,888	1939	41	1931
	290	1900	6,880	1901	998	1902	1907	623	1924	112	1939
	1,097	1904	4,358	1907	654	1908	1909	2,573	1926		
	280	1909	4,280	1911	4,390	1912	1910	523	1916	30	1932
	1,413	1913	332	1914	68	1915	1911	2,063	1924	22	1925
	847	1916	300	1922	320	1923		28	1938		
	2,220	1924	705	1925	493	1927	1914	22	1940		
	2,688	1928	61	1929	2,528	1930	1915	36	1926		
	183	1931	70	1934	437	1936	1916	36	1931		
	528	1940					1917	27	1928		
1891	915	1916	3,677	1918	200	1921	1919	27	1940		
	1,415	1924	56	1925	124	1926	1927	179	1937		
	2,096	1927	1,858	1928	6,101	1930					
	2,361	1931	7,487	1932	309	1934					
	1,306	1938	1,451	1940							

SURVIVAL AND RETIREMENT

6-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet			Year Installed	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1878	34,405	34,405	0	1912	32,331	29,424	2,907
1880	68	0	68	1913	29,974	29,371	603
1881	9,503	0	9,503	1914	11,473	11,473	0
1883	29,209	19,093	10,116	1915	4,581	4,581	0
1884	22,615	18,035	4,580	1916	37,258	36,823	435
1885	8,442	8,442	0	1917	3,041	3,035	6
1886	9,607	7,692	1,915	1918	2,259	2,259	0
1887	48,261	48,261	0	1919	16,049	15,657	392
1888	35,989	29,124	6,865	1920	3,618	3,427	191
1889	36,252	31,166	5,086	1921	18,978	18,049	929
1890	434,430	386,768	47,662	1922	44,591	44,562	29
1891	66,732	49,711	17,021	1923	29,630	28,358	1,272
1892	149,500	19,963	129,537	1924	57,635	56,105	1,530
1893	10,902	8,373	2,529	1925	21,453	21,260	193
1894	50,860	50,395	465	1926	15,808	15,483	325
1895	52,613	42,457	10,156	1927	33,231	33,019	212
1896	10,566	9,249	1,317	1928	21,900	21,879	21
1897	5,517	5,517	0	1929	13,300	13,300	0
1898	1,247	1,247	0	1930	22,412	22,141	271
1899	17,802	17,025	777	1931	28,346	28,306	40
1900	14,976	11,901	3,075	1932	5,703	5,703	0
1901	66,572	63,936	2,636	1933	3,147	3,147	0
1902	49,447	44,966	4,481	1934	325	325	0
1903	10,279	8,651	1,628	1935	3,459	3,438	21
1904	19,910	18,658	1,342	1936	13,033	13,033	0
1905	20,506	19,165	1,341	1937	15,442	15,442	0
1906	43,373	43,373	0	1938	8,859	8,859	0
1907	32,361	32,103	258	1939	21,203	21,203	0
1908	11,057	10,868	189	1940	23,795	23,795	0
1909	8,695	8,695	0				
1910	19,480	18,787	693				
1911	41,345	37,538	3,807				
				TOTAL	1,915,355	1,638,931	276,424

Retirements by Years

<i>Year</i>							<i>Year</i>						
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1880	68	1932					1890	4,755	1907	329	1908	651	1910
1881	36	1895	3,332	1896	480	1900		415	1911	28	1913	73	1914
	4,050	1901	580	1903	1,025	1906		31	1915	80	1916	24	1917
1883	3,840	1894	337	1895	12	1899		523	1920	360	1921	421	1922
	1,660	1901	2,600	1903	1,322	1914		1,339	1923	125	1926	88	1927
	345	1917						130	1928	256	1929	1,828	1931
1884	455	1895	75	1899	4,050	1905		79	1934	467	1935	46	1936
1886	45	1895	1,870	1907				26	1937	200	1938	471	1939
1888	200	1890	829	1895	2,446	1904	1891	1,778	1895	4,290	1901	25	1902
	756	1906	2,634	1920				105	1905	118	1906	940	1907
1889	1,012	1895	2,350	1901	630	1903		1,946	1914	80	1915	310	1916
	544	1906	550	1925				721	1917	1,993	1918	29	1921
1890	1,525	1895	5,210	1896	154	1898		430	1923	708	1924	683	1925
	669	1900	16,680	1901	6,103	1902		350	1926	30	1927	318	1930
	3,597	1903	73	1905	906	1906		29	1936	630	1938	1,508	1940

6-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year						Year					
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year
1892	19,686	1895	2,192	1896	8,495	1899	1905	120	1912	355	1923
	21,021	1900	46,527	1901	16,040	1902		524	1931		
	5,258	1904	25	1905	455	1906	1907	106	1922	57	1929
	328	1911	136	1915	3,283	1922	1908	180	1916	9	1924
	1,730	1923	690	1926	2,646	1930	1910	665	1920	28	1931
	600	1932	425	1933			1911	880	1912	1,531	1924
1893	720	1896	35	1925	1,456	1926		112	1932		1,284 1926
	318	1938					1912	668	1924	1,309	1927
1894	400	1923	65	1924				217	1932		713 1930
1895	1,790	1907	1,622	1913	769	1921	1913	5	1930	100	1931
	366	1922	3,164	1923	21	1924	1916	323	1922	112	1928
	23	1926	1,352	1927	135	1932	1917	6	1927		
	693	1933	221	1937			1919	364	1924	28	1926
1896	641	1908	676	1939			1920	56	1920	15	1928
1899	522	1906	50	1913	175	1927	1921	912	1931	12	1938
	30	1930					1922	29	1928		5 1940
1900	2,090	1907	470	1912	406	1923	1923	287	1923	62	1927
	109	1937						82	1930	692	1932
1901	473	1912	375	1923	1,320	1924	1924	37	1928	165	1930
	443	1931	25	1932				626	1932	30	1939
1902	24	1904	2,302	1907	340	1913	1925	43	1927	22	1930
	1,246	1927	255	1932	232	1933		68	1940		60 1932
	52	1935	30	1937			1926	325	1932		
1903	90	1907	308	1923	200	1924	1927	83	1928	129	1931
	55	1929	374	1932	601	1933	1928	10	1930	11	1931
1904	320	1907	82	1925	211	1928	1930	76	1932	195	1940
	81	1929	563	1931	85	1932	1931	40	1932		
							1935	21	1939		

8-IN. CAST-IRON UNLINED MAINS

Year				Year			
Feet				Feet			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1881	3,156	3,005	151	1901	114	114	0
1883	5,448	5,448	0	1902	653	627	26
1888	336	336	0	1903	431	431	0
1889	16,422	16,041	381	1904	77	33	44
1890	81,764	66,973	14,791	1906	514	514	0
1891	63,379	54,088	9,291	1907	616	616	0
1892	11,903	11,336	567	1908	442	90	352
1893	5,284	5,167	117	1909	273	273	0
1894	155	155	0	1910	522	448	74
1895	12,805	11,795	1,010	1911	566	566	0
1896	130	130	0	1912	131	131	0
1897	1,276	906	370	1913	2,210	2,210	0
1898	39	39	0	1914	2,440	2,440	0
1899	48	48	0	1915	75	75	0
1900	182	182	0	1916	67	67	0

SURVIVAL AND RETIREMENT

8-IN. CAST-IRON UNLINED MAINS (contd.)

Year	Feet			Year	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1917	79	79	0	1931	46,223	46,223	0
1920	3,072	3,072	0	1932	21,436	21,436	0
1921	1,398	1,398	0	1933	2,169	2,169	0
1922	3,351	3,351	0	1934	553	553	0
1923	276	276	0	1935	962	962	0
1924	5,507	5,507	0	1936	8,020	8,020	0
1926	3,056	3,056	0	1937	3,467	3,467	0
1927	5,576	5,576	0	1938	2,450	2,450	0
1928	9,191	9,055	136	1939	28,616	28,616	0
1929	4,747	4,747	0	1940	22,219	22,219	0
1930	10,250	10,221	29				
				TOTAL	394,076	366,737	27,339

Retirements by Years

Year			Year			Year			Year		
	Installed	Feet		Installed	Feet		Installed	Feet		Installed	Feet
1881	151	1894		1891	232	1922	3,159	1931			
1889	381	1895		1892	475	1904	92	1912			
1890	80	1894	5,465	1893	117	1936					
	920	1901	668	1895	32	1902	481	1904	125	1927	
	85	1907	37		372	1928					
	204	1915	84		1897	370	1908				
	46	1924	58		1902	26	1933				
	333	1938	24		1904	33	1925	11	1931		
1891	105	1894	1,700		1908	62	1916	290	1923		
	32	1901	2,657		1910	74	1933				
	161	1905	55		1928	118	1931	18	1937		
	54	1914	75		1930	29	1938				

10-IN. CAST-IRON UNLINED MAINS

Year	Feet			Year	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1881	4,397	4,397	0	1906	1,354	1,354	0
1883	5,113	2,313	2,800	1912	2,661	2,661	0
1887	1,968	1,968	0	1920	32	32	0
1888	6,387	6,387	0	1921	88	0	88
1889	6,863	5,597	1,266	1922	3,832	3,832	0
1890	30,639	24,332	6,307	1924	946	946	0
1891	11,213	9,129	2,084	1927	153	153	0
1892	332	0	332	1929	12	12	0
1893	13,183	8,425	4,758	1931	4	4	0
1894	6,699	6,699	0	1932	156	156	0
1895	3,200	2,815	385	1936	25	25	0
1899	772	772	0	1938	8	8	0
1900	1,364	1,364	0	1940	15	15	0
1901	3,638	3,638	0				
1903	3,484	3,237	247	TOTAL	109,953	91,686	18,267
1904	1,415	1,415	0				

SURVIVAL AND RETIREMENT

14-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1888	550	218	332
1890	20,296	20,139	157
1891	9,319	9,239	80
1892	3,996	3,996	0
1894	272	147	125
1895	95	91	4
1903	132	0	132
1909	36	36	0
1910	8	8	0
1916	62	0	62
1920	20	20	0
1928	54	54	0
1940	0	0	0
TOTAL	34,840	33,948	892

Retirements by Years

Year	Feet		Year	Feet		Year	Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1888	332	1895						
1890	60	1895	24	1902	50	1911		
	23	1932						
1891	80	1894						
1894	125	1932						
1895	4	1925						
1903	132	1907						
1916	62	1925						

15-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1872	6,177	6,177	0
1940	0	0	0
TOTAL	6,177	6,177	0

16-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1887	3,678	3,480	198
1890	37,437	31,033	6,404
1891	12,456	12,373	83
1893	48	48	0
1894	70	70	0
1895	94	17	77
1899	3,769	3,769	0
1901	884	756	128
1903	8,025	5,683	2,342
1904	529	529	0
1906	1,162	1,162	0
1907	2,271	2,271	0

16-IN. CAST-IRON UNLINED MAINS (contd.)

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1908	3,601	3,551	50
1910	483	483	0
1915	2,251	2,251	0
1917	355	355	0
1918	113	113	0
1919	7,052	6,998	54
1920	2,126	1,830	296
1923	4,424	4,424	0
1924	1,489	1,364	125
1925	28	28	0
1926	1,334	1,334	0
1927	2,542	2,502	40
1931	5,904	5,904	0
1932	40	40	0
1934	62	62	0
1937	406	406	0
1940	8,865	8,865	0

TOTAL 111,498 101,701 9,797

Retirements by Years

Year	Feet		Year	Feet		Year	Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1887	198	1895						
1890	117	1901	5,770	1902	71	1904		
	90	1911	356	1917				
1891	29	1913	54	1925				
1895	77	1925						
1901	128	1922						
1903	2,280	1907	62	1934				
1908	36	1927	14	1937				
1919	54	1932						
1920	296	1940						
1924	125	1933						
1927	40	1933						

18-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1888	140	0	140
1890	15,343	15,153	190
1891	1,759	1,759	0
1901	36	36	0
1907	895	895	0
1908	887	872	15
1914	125	125	0
1923	17	17	0
1924	5,300	5,300	0
1925	45	45	0
1927	47	38	9
1931	1,892	1,892	0
1933	3	3	0

18-IN. CAST-IRON UNLINED MAINS (contd.)

Year	Feet		
Installed	Installed	In Service	Retired
1937	22	22	0
1940	0	0	0
TOTAL	26,511	26,157	354

Retirements by Years			
Year	Feet	Year	Feet
1888	140	1895	
1890	190	1914	
1908	15	1937	
1927	9	1937	

20-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1880	500	52	448
1881	4,800	1,452	3,348
1888	2,290	400	1,890
1889	2,376	566	1,810
1890	450	450	0
1891	2,393	480	1,913
1895	125	71	54
1899	6,022	3,791	2,231
1903	1,510	1,160	350
1908	464	388	76
1910	1,545	1,545	0
1920	9,551	9,551	0
1923	31	31	0
1924	9,191	9,174	17
1925	72	72	0
1926	3,930	3,930	0
1927	6	6	0
1937	16	16	0
1938	2,109	2,109	0
1940	0	0	0
TOTAL	47,381	35,244	12,137

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year	Feet
1880	53	1932	395	1934			
1881	986	1894	812	1895	1,100	1903	
	450	1913					
1888	1,890	1896					
1889	815	1896	995	1899			
1891	1,913	1899					
1895	47	1925	7	1940			
1899	2,231	1937					
1903	350	1937					
1908	35	1927	41	1940			
1924	17	1939					

24-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1890	19,701	18,137	1,564
1891	1,877	1,877	0
1892	22,250	20,882	1,368
1893	38	38	0
1897	6	6	0
1901	9,240	7,786	1,454
1902	27	27	0
1908	3,569	3,569	0
1910	7,625	7,625	0
1911	84	32	52
1913	486	486	0
1917	249	249	0
1918	3,430	3,430	0
1920	1,838	1,838	0
1922	337	337	0
1923	14,440	14,440	0
1924	10,538	10,538	0
1925	48	48	0
1926	2,976	2,976	0
1927	12,656	12,656	0
1930	65	0	65
1932	6,189	6,169	20
1933	201	201	0
1935	36	36	0
1936	18	18	0
1938	422	422	0
1939	564	564	0
1940	2,122	2,122	0
TOTAL	121,032	116,509	4,523

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year	Feet
1890	530	1906	825	1922	6	1923	
	75	1933	20	1934	108	1935	
1892	104	1895	105	1900	1,159	1906	
1901	1,350	1910	104	1940			
1911	52	1933					
1930	65	1933					
1932	20	1938					

30-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1888	1,517	1,349	168
1890	55	55	0
1903	3,795	3,795	0
1917	15,901	15,901	0
1923	9,178	9,178	0
1924	3,208	3,208	0

SURVIVAL AND RETIREMENT

30-IN. CAST-IRON UNLINED MAINS (contd.)

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	5,606	5,606	0
1927	14,321	14,055	266
1932	279	279	0
1933	150	150	0
1937	369	369	0
1938	14	14	0
1939	66	66	0
1940	35	35	0

TOTAL	54,494	54,060	434
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Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1888	168	1898
1927	266	1932

36-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1924	4,215	4,215	0
1925	8,733	8,733	0
1927	1,348	1,348	0
1933	264	264	0
1936	41	41	0
1940	0	0	0

TOTAL	14,601	14,601	0
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39.37-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1924	2,286	2,286	0
1940	0	0	0

TOTAL	2,286	2,286	0
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41.34-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1924	2,483	2,483	0
1940	0	0	0

TOTAL	2,483	2,483	0
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42-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1924	64	64	0
1925	70	70	0
1940	9	9	0

TOTAL	143	143	0
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48-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	166	166	0
1933	84	84	0
1940	0	0	0

TOTAL	250	250	0
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24-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1911	2,582	2,582	0
1935	101	101	0
1940	80	80	0

TOTAL	2,763	2,763	0
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24-IN. WOOD-STAVE MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	4,000	0	4,000
1901	2,552	0	2,552
1940	0	0	0

TOTAL	6,552	0	6,552
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Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1889	4,000	1900
1901	2,552	1928

30-IN. OD. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1928	2,533	2,533	0
1940	0	0	0

TOTAL	2,533	2,533	0
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30-IN. CONCRETE MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	13,915	13,915	0
1939	2,947	2,947	0
1940	0	0	0
TOTAL	16,862	16,862	0

30-IN. WOOD-STAVE MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1888	193	0	193
1892	2,320	0	2,320
1940	0	0	0
TOTAL	2,513	0	2,513

Retirements by Years

Year	Feet	Year	Feet	Year
<i>Installed</i>				
1888	193	1891		
1892	1,200	1910	1,120	1921

42-IN. CONCRETE MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1940	3,169	3,169	0
TOTAL	3,169	3,169	0

46-IN. CONCRETE MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1940	6,968	6,968	0
TOTAL	6,968	6,968	0

30-IN. CAST-IRON UNLINED—CONDUIT No. 1

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1890	17,571	17,279	292
1920	193	193	0
1921	89	89	0
1925	76	76	0
1928	58	58	0
1940	0	0	0
TOTAL	17,987	17,695	292

30-IN. CAST-IRON UNLINED—CONDUIT No. 1
(contd.)

Retirements by Years				
Year	Feet	Year	Feet	Year
<i>Installed</i>				
1890	68	1920	224	1929

36-IN. CAST-IRON UNLINED—CONDUIT No. 1

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1920	6,920	6,920	0
1940	0	0	0
TOTAL	6,920	6,920	0

30-IN. WOOD-STAVE—CONDUIT No. 1

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1890	91,380	0	91,380
1920	3,626	0	3,626
1921	69	0	69
1925	117	0	117
1928	979	0	979
1940	0	0	0
TOTAL	96,171	0	96,171

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year
<i>Installed</i>						
1890	10,691	1920	97	1921	23,750	1922
	20,628	1925	4,032	1928	10,579	1929
	17,039	1930	4,564	1936		
1920	3,626	1936				
1921	69	1936				
1925	117	1936				
1928	979	1936				

30-IN. CAST-IRON UNLINED—CONDUIT No. 2

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	128	128	0
1915	64	64	0
1918	272	117	155
1924	24	24	0
1928	40	40	0
1930	251	251	0
1938	11	11	0
1940	0	0	0
TOTAL	790	635	155

30-IN. CAST-IRON UNLINED—CONDUIT No. 2
(contd)

<i>Retirements by Years</i>		
<i>Year</i>		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1918	155	1940

30-IN. WOOD-STAVE—CONDUIT No. 2

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	14,727	0	14,727
1940	0	0	0
TOTAL	14,727	0	14,727

<i>Retirements by Years</i>						
<i>Year</i>						
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1893	330	1922	40	1928	600	1934
	13,757	1940				

34-IN. STEEL—CONDUIT No. 2

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	892	892	0
1924	3,270	3,270	0
1940	0	0	0
TOTAL	4,162	4,162	0

34-IN. WOOD-STAVE—CONDUIT No. 2

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	86,594	38,960	47,634
1922	105	105	0
1923	2,311	2,311	0
1927	640	640	0
1930	384	384	0
1931	368	368	0
1932	400	400	0
1935	250	250	0
1938	1,124	1,124	0
1940	0	0	0
TOTAL	92,176	44,542	47,634

34-IN. WOOD-STAVE—CONDUIT No. 2 (contd.)

<i>Retirements by Years</i>						
<i>Year</i>						
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1893	41	1910	108	1920	2,311	1923
	3,294	1924	640	1927	659	1930
	1,835	1931	400	1932	250	1935
	1,535	1938	4,449	1939	32,112	1940

36-IN. WOOD-STAVE—CONDUIT No. 2

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1903	2,264	0	2,264
1940	0	0	0
TOTAL	2,264	0	2,264

<i>Retirements by Years</i>			
<i>Year</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1903	2,264	1940	

36-IN. CAST-IRON UNLINED—CONDUIT No. 2

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1903	41	0	41
1940	0	0	0
TOTAL	41	0	41

<i>Retirements by Years</i>			
<i>Year</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1903	41	1940	

38-IN. CONCRETE LINED TUNNEL—
CONDUIT No. 2

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	12,336	4,614	7,722
1940	0	0	0
TOTAL	12,336	4,614	7,722

<i>Retirements by Years</i>			
<i>Year</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1893	7,722	1940	

16-IN. SLIP-JOINT STEEL PIPE—
CONDUIT NO. 3

Year	Feet		
Installed	Installed	In Service	Retired
1933	300	300	0
1940	0	0	0
TOTAL	300	300	0

30-IN. WOOD-STAVE—CONDUIT NO. 3

Year	Feet		
Installed	Installed	In Service	Retired
1899	19,519	0	19,519
1924	2,113	2,113	0
1935	156	156	0
1940	0	0	0
TOTAL	21,788	2,269	19,519

Retirements by Years

Year	Feet	Year	Feet	Year
Installed				
1899	26	1923	19,493	1924

30-IN. CAST-IRON UNLINED—CONDUIT NO. 3

Year	Feet		
Installed	Installed	In Service	Retired
1899	2,898	2,211	687
1919	40	40	0
1921	34	34	0
1923	26	26	0
1924	636	636	0
1940	0	0	0
TOTAL	3,634	2,947	687

Retirements by Years

Year	Feet	Year	Feet	Year
Installed				
1899	616	1924	71	1926

30-IN. CONCRETE—CONDUIT NO. 3

Year	Feet		
Installed	Installed	In Service	Retired
1939	26,303	26,303	0
1940	0	0	0
TOTAL	26,303	26,303	0

34-IN. WOOD-STAVE—CONDUIT NO. 3

Year	Feet		
Installed	Installed	In Service	Retired
1899	3,900	0	3,900
1940	0	0	0
TOTAL	3,900	0	3,900

Retirements by Years

Years	Feet	Year	Feet	Year
Installed				
1899	24	1919	3,876	1924

36-IN. WOOD-STAVE—CONDUIT NO. 3

Year	Feet		
Installed	Installed	In Service	Retired
1899	2,822	197	2,625
1940	0	0	0
TOTAL	2,822	197	2,625

Retirements by Years

Year	Feet	Year
Installed		
1899	2,625	1924

36-IN. CAST-IRON UNLINED—CONDUIT NO. 3

Year	Feet		
Installed	Installed	In Service	Retired
1924	25,576	25,541	35
1926	110	110	0
1940	0	0	0
TOTAL	25,686	25,651	35

Retirements by Years

Year	Feet	Year
Installed		
1924	35	1932

40-IN. WOOD-STAVE—CONDUIT NO. 3

Year	Feet		
Installed	Installed	In Service	Retired
1899	89,728	0	89,728
1919	2,393	0	2,393
1921	3,168	0	3,168
1925	1,414	64	1,350
1928	1,448	1,448	0

40-IN. WOOD-STAVE—CONDUIT No. 3 (contd.)

Year	Feet		
Installed	Installed	In Service	Retired
1931	590	590	0
1934	495	495	0
1935	840	840	0
1940	0	0	0
TOTAL	100,076	3,437	96,639

Retirements by Years

Year							
Installed	Feet	Year	Feet	Year	Feet	Year	
1899	2,383	1919	3,188	1921	2,445	1924	
	25,125	1925	1,448	1927	590	1931	
	18,270	1932	495	1934	1,056	1935	
	34,728	1939					
1919	2,393	1939					
1921	3,168	1939					
1925	1,350	1939					

42-IN. CAST-IRON UNLINED—CONDUIT No. 3

Year	Feet		
Installed	Installed	In Service	Retired
1899	440	440	0
1925	101	101	0
1940	0	0	0
TOTAL	541	541	0

36-IN. CAST-IRON UNLINED—CONDUIT No. 4

Year	Feet		
Installed	Installed	In Service	Retired
1884	1,008	0	1,008
1940	0	0	0
TOTAL	1,008	0	1,008

Retirements by Years

Year		
Installed	Feet	Year
1884	1,008	1930

40-IN. WOOD-STAVE—CONDUIT No. 4

Year	Feet		
Installed	Installed	In Service	Retired
1884	8,075	0	8,075
1940	0	0	0
TOTAL	8,075	0	8,075

40-IN. WOOD-STAVE—CONDUIT No. 4 (contd.)

Retirements by Years		
Year	Feet	Year
1884	8,075	1930

48-IN. WOOD-STAVE—CONDUIT No. 4

Year	Feet		
Installed	Installed	In Service	Retired
1884	5,452	0	5,452
1940	0	0	0
TOTAL	5,452	0	5,452

Retirements by Years

Year	Feet	Year
1884	5,452	1930

30-IN. WOOD-STAVE—CONDUIT No. 5

Year	Feet		
Installed	Installed	In Service	Retired
1907	25,385	21,285	4,100
1925	791	791	0
1926	1,252	1,252	0
1927	21	21	0
1934	1,120	1,120	0
1935	210	210	0
1940	0	0	0
TOTAL	28,779	24,679	4,100

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year
1907	791	1925	1,252	1926	697	1927
	30	1932	1,120	1934	210	1935

30-IN. CAST-IRON UNLINED—CONDUIT No. 5

Year	Feet		
Installed	Installed	In Service	Retired
1907	57	57	0
1927	32	32	0
1932	30	30	0
1940	0	0	0
TOTAL	119	119	0

36-IN. CONCRETE—CONDUIT NO. 5

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1907	2,248	2,248	0
1927	644	644	0
1940	0	0	0
TOTAL	2,892	2,892	0

36-IN. CAST-IRON UNLINED—CONDUIT NO. 5

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1907	990	990	0
1940	0	0	0
TOTAL	990	990	0

36-IN. WOOD-STAVE—CONDUIT NO. 5

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1907	50	50	0
1940	0	0	0
TOTAL	50	50	0

36-IN. CAST-IRON UNLINED—CONDUIT NO. 6

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	374	374	0
1922	84	84	0
1939	170	170	0
1940	0	0	0
TOTAL	628	628	0

40-IN. WOOD-STAVE—CONDUIT NO. 6

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	6,105	0	6,105
1940	0	0	0
TOTAL	6,105	0	6,105

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1910	6,105	1940

44-IN. WOOD-STAVE—CONDUIT NO. 6

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	8,517	1,171	7,346
1940	0	0	0
TOTAL	8,517	1,171	7,346

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1893	7,346	1940

48-IN. WOOD-STAVE—CONDUIT NO. 6

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	56,226	0	56,226
1930	126	0	126
1940	0	0	0
TOTAL	56,352	0	56,352

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year
<i>Installed</i>		<i>Feet</i>		<i>Feet</i>		<i>Feet</i>
1910	84	1922	17	1924	255	1927
	4,312	1928	13,303	1930	29	1934
	449	1936	16,955	1939	20,822	1940
1930	121	1932	5	1933		

48-IN. CAST-IRON UNLINED—CONDUIT NO. 6

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	486	0	486
1924	17	0	17
1927	307	0	307
1930	36	0	36
1934	29	0	29
1940	0	0	0
TOTAL	875	0	875

Retirements by Years

Year	Feet	Year	Feet	Year
<i>Installed</i>		<i>Feet</i>		
1910	139	1928	347	1930
1924	17	1940		
1927	291	1930	16	1940
1930	36	1940		
1934	29	1940		

48-IN. STEEL—CONDUIT No. 6

Year	Feet		
Installed	Installed	In Service	Retired
1910	1,542	0	1,542
1936	285	0	285
1940	0	0	0
TOTAL	1,827	0	1,827

Retirements by Years

Year	Feet	Year	Feet	Year	Feet
Installed	Year	Feet	Year	Feet	Year
1910	100 1928	732 1930	140 1939		
	570 1940				
1936	40 1939	245 1940			

48-IN. WOOD-STAVE—CONDUIT No. 7

Year	Feet		
Installed	Installed	In Service	Retired
1911	52,531	50,463	2,068
1927	706	706	0
1933	274	274	0
1935	750	750	0
1940	338	338	0
TOTAL	54,599	52,531	2,068

Retirements by Years

Year	Feet	Year	Feet	Year	Feet
Installed	Year	Feet	Year	Feet	Year
1911	706 1927	274 1933	750 1935		
	338 1940				

48-IN. CAST-IRON UNLINED—CONDUIT No. 7

Year	Feet		
Installed	Installed	In Service	Retired
1911	386	386	0
1940	0	0	0
TOTAL	386	386	0

60-IN. WOOD-STAVE—CONDUIT No. 8

Year	Feet		
Installed	Installed	In Service	Retired
1911	12,390	11,676	714
1928	100	100	0
1929	455	455	0
1940	138	138	0
TOTAL	13,083	12,369	714

60-IN. WOOD-STAVE—CONDUIT No. 8 (contd.)

Retirements by Years

Year	Feet	Year	Feet	Year	Feet
Installed	Year	Feet	Year	Feet	Year
1911	21 1925	100 1928	455 1929		
	138 1940				

60-IN. CAST-IRON UNLINED—CONDUIT No. 8

Year	Feet		
Installed	Installed	In Service	Retired
1911	67	67	0
1940	0	0	0
TOTAL	67	67	0

60-IN. STEEL—CONDUIT No. 8

Year	Feet		
Installed	Installed	In Service	Retired
1911	1,112	1,112	0
1925	21	21	0
1940	0	0	0
TOTAL	1,133	1,133	0

72-IN. CONCRETE LINED TUNNEL—
CONDUIT No. 8

Year	Feet		
Installed	Installed	In Service	Retired
1911	66	66	0
1940	0	0	0
TOTAL	66	66	0

36-IN. WOOD-STAVE—CONDUIT
No. 8 EXTENSION

Year	Feet		
Installed	Installed	In Service	Retired
1911	3,697	3,697	0
1940	0	0	0
TOTAL	3,697	3,697	0

36-IN. CAST-IRON UNLINED—CONDUIT
No. 8 EXTENSION

Year	Feet		
Installed	Installed	In Service	Retired
1911	356	356	0
1940	0	0	0
TOTAL	356	356	0

36-IN. WOOD-STAVE—CONDUIT No. 9

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1916	1,208	0	1,208
1918	1,209	0	1,209
1940	0	0	0
TOTAL	2,417	0	2,417

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1916	1,208	1937
1918	1,209	1937

36-IN. CAST-IRON UNLINED—CONDUIT No. 9

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1915	106	0	106
1916	152	0	152
1917	41	0	41
1918	85	0	85
1925	28	0	28
1937	43	43	0
1940	0	0	0
TOTAL	455	43	412

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year
<i>Installed</i>						
1915	47	1925	41	1936	18	1937
1916	152	1937				
1917	41	1937				
1918	85	1937				
1925	28	1937				

48-IN. WOOD-STAVE—CONDUIT No. 9

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1915	29,498	0	29,498
1917	2,469	0	2,469
1927	700	0	700
1928	468	0	468
1932	200	0	200
1936	2,469	0	2,469
1940	0	0	0
TOTAL	35,804	0	35,804

48-IN. WOOD-STAVE—CONDUIT No. 9 (contd.)

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year
<i>Installed</i>						
1915	1,009	1925	700	1927	468	1928
	200	1932	27,121	1937		
1917	2,469	1936				
1927	700	1937				
1928	468	1937				
1932	200	1937				
1936	2,469	1939				

48-IN. CAST-IRON UNLINED—CONDUIT No. 9

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1915	617	0	617
1917	85	0	85
1918	87	0	87
1936	172	93	79
1940	0	0	0
TOTAL	961	93	868

Retirements by Years

Year	Feet	Year	Feet	Year
<i>Installed</i>				
1915	172	1936	445	1937
1917	85	1937		
1918	87	1937		
1936	47	1937	32	1939

48-IN. STEEL—CONDUIT No. 9

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1915	1,518	0	1,518
1940	0	0	0
TOTAL	1,518	0	1,518

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1915	1,518	1937

54-IN. CONCRETE—CONDUIT No. 9

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	986	324	662
1940	0	0	0
TOTAL	986	324	662

Retirements by Years

Year	Feet	Year
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1925	986	1939

Note: 324 ft. transferred to conduit No. 19—still in service.

30-IN. STEEL—CONDUIT No. 10

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1929	2,936	0	2,936
1940	0	0	0
TOTAL	2,936	0	2,936

Retirements by Years

Year	Feet	Year
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1929	2,936	1940

36-IN. CAST-IRON UNLINED—CONDUIT No. 10

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1921	36	36	0
1924	108	108	0
1940	0	0	0
TOTAL	144	144	0

54-IN. CONCRETE—CONDUIT No. 10

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1921	27,100	27,100	0
1924	20,446	20,446	0
1940	0	0	0
TOTAL	47,546	47,546	0

60-IN. STEEL—CONDUIT No. 11

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	46	46	0
1940	0	0	0
TOTAL	46	46	0

66-IN. WOOD-STAVE—CONDUIT No. 11

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	52,427	39,830	12,597
1932	1,037	1,037	0
1933	2,810	2,810	0
1934	785	785	0
1935	1,002	1,002	0
1936	1,241	1,241	0
1937	2,076	2,076	0
1938	2,396	2,396	0
1939	600	600	0
1940	650	650	0
TOTAL	65,024	52,427	12,597

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1925	1,037	1932	2,810	1933	785	1934
	1,002	1935	1,241	1936	2,076	1937
	2,396	1938	600	1939	650	1940

66-IN. CONCRETE—CONDUIT No. 11

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	260	260	0
1940	0	0	0
TOTAL	260	260	0

66-IN. STEEL—CONDUIT No. 11

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	104	104	0
1940	0	0	0
TOTAL	104	104	0

48-IN. STEEL—CONDUIT No. 12

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	5,439	5,439	0
1940	0	0	0
TOTAL	5,439	5,439	0

54-IN. STEEL—CONDUIT No. 12

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	8,936	8,936	0
1940	0	0	0
TOTAL	8,936	8,936	0

66-IN. STEEL—CONDUIT No. 12

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	195	195	0
1940	0	0	0
TOTAL	195	195	0

66-IN. CONCRETE—CONDUIT No. 12

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	31,211	31,211	0
1940	0	0	0
TOTAL	31,211	31,211	0

84-IN. CONCRETE—CONDUIT No. 12

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	619	619	0
1940	0	0	0
TOTAL	619	619	0

54-IN. CONCRETE—CONDUIT No. 13

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	103	103	0
1940	0	0	0
TOTAL	103	103	0

60-IN. CONCRETE—CONDUIT No. 13

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	57,722	57,722	0
1940	0	0	0
TOTAL	57,722	57,722	0

66-IN. STEEL—CONDUIT No. 13

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1928	4,521	4,521	0
1930	53	53	0
1940	0	0	0
TOTAL	4,574	4,574	0

16-IN. CAST-IRON UNLINED—CONDUIT No. 16

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1939	1,941	1,941	0
1940	0	0	0
TOTAL	1,941	1,941	0

42-IN. STEEL—CONDUIT No. 16

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	45,613	45,613	0
1940	0	0	0
TOTAL	45,613	45,613	0

30-IN. STEEL—CONDUIT No. 17

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	631	631	0
1940	0	0	0
TOTAL	631	631	0

36-IN. STEEL—CONDUIT No. 17

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	244	244	0
1940	0	0	0
TOTAL	244	244	0

SURVIVAL AND RETIREMENT

51-IN. OD. STEEL—CONDUIT No. 17

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	6,344	6,344	0
1940	0	0	0
TOTAL	6,344	6,344	0

57-IN. OD. STEEL—CONDUIT No. 17

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	12,581	12,581	0
1940	0	0	0
TOTAL	12,581	12,581	0

63-IN. OD. STEEL—CONDUIT No. 17

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	17,563	17,563	0
1940	0	0	0
TOTAL	17,563	17,563	0

54-IN. CONCRETE—CONDUIT No. 18

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	21,280	21,280	0
1940	0	0	0
TOTAL	21,280	21,280	0

42-IN. CONCRETE—CONDUIT No. 19

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	20,550	20,550	0
1940	0	0	0
TOTAL	20,550	20,550	0

54-IN. CONCRETE—CONDUIT No. 19

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	324	324	0
1940	0	0	0
TOTAL	324	324	0

VALVES

1-IN. VALVES

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1895	1	1	0
1901	2	1	1
1902	1	1	0
1904	3	2	1
1905	1	0	1
1906	1	1	0
1907	5	2	3
1908	2	2	0
1909	2	1	1
1910	2	1	1
1911	2	1	1
1913	1	0	1
1914	1	1	0
1917	1	0	1
1924	1	1	0
1925	1	1	0
1926	1	1	0
1927	1	1	0

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1928	1	1	0
1940	0	0	0
TOTAL	30	19	11

Retirements by Years

Year	Num-	Year	Num-	Year	Num-
<i>Installed</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>
1901	1	1926			
1904	1	1938			
1905	1	1939			
1907	1	1924	1	1931	1
1909	1	1925			
1910	1	1929			
1911	1	1928			
1913	1	1923			
1917	1	1927			

1½-IN. VALVES

<i>Year Installed</i>	<i>Number</i>			<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1890	2	0	2	1936	1	1	0
1898	1	1	0	1938	1	1	0
1903	1	1	0	1940	0	0	0
1904	3	0	3				
1905	1	0	1	TOTAL	34	18	16
1906	3	0	3				
1907	2	1	1				
1908	3	3	0				
1909	3	0	3				
1911	1	1	0				
1914	1	1	0				
1915	1	1	0				
1917	2	2	0				
1918	1	1	0				
1919	1	1	0				
1922	2	2	0				
1923	2	0	2				
1924	1	0	1				
1931	1	1	0				

Retirements by Years

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1890	2	1922				
1904	2	1923	1	1926		
1905	1	1928				
1906	1	1925	1	1926	1	1928
1907	1	1931				
1909	2	1925	1	1940		
1923	1	1930	1	1931		
1924	1	1926				

1½-IN. VALVES

<i>Year Installed</i>	<i>Number</i>			<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1892	2	0	2	1892	2	1923	
1898	1	1	0	1905	1	1924	1
1903	1	1	0	1906	1	1926	1
1904	2	2	0	1907	1	1928	
1905	2	0	2	1908	1	1924	1
1906	2	0	2		1	1930	
1907	4	3	1		1	1926	1
1908	8	4	4		1	1928	
1909	4	2	2		1	1926	1
1910	7	4	3		1	1926	
1911	1	1	0		1	1928	
1912	4	3	1		1	1927	
1914	1	0	1		1	1926	
1915	1	0	1		1	1927	
1916	1	0	1		1	1935	
1918	1	0	1		1	1938	
1924	10	9	1				
1925	2	2	0				
1928	2	2	0				
1929	1	1	0				
1932	2	1	1				
1940	1	1	0				
TOTAL	60	37	23				

SURVIVAL AND RETIREMENT

2-IN. VALVES

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1890	14	0	14	1919	8	4	4
1891	1	1	0	1920	27	17	10
1892	10	0	10	1921	70	31	39
1893	5	0	5	1922	182	106	76
1894	3	0	3	1923	124	64	60
1896	2	0	2	1924	81	43	38
1897	3	0	3	1925	70	47	23
1898	2	0	2	1926	53	43	10
1902	1	0	1	1927	33	30	3
1903	6	3	3	1928	22	14	8
1904	14	6	8	1929	12	10	2
1905	19	7	12	1930	12	11	1
1906	19	6	13	1931	11	8	3
1907	10	3	7	1932	9	7	2
1908	27	16	11	1933	5	5	0
1909	52	20	32	1934	2	2	0
1910	41	10	31	1935	8	8	0
1911	48	21	27	1936	4	3	1
1912	22	7	15	1937	10	10	0
1913	18	0	18	1938	10	9	1
1914	9	5	4	1939	14	12	2
1915	7	4	3	1940	11	11	0
1916	5	2	3				
1917	8	2	6				
1918	5	3	2				
				TOTAL	1,129	611	518

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1890	6	1911	3	1912	3	1923		1909	2	1929	4	1930	5	1931
	1	1924	1	1927					1	1933	2	1937		
1892	3	1923	6	1924	1	1933		1910	4	1923	9	1924	2	1925
1893	1	1935	2	1936	2	1937			1	1926	3	1927	3	1928
1894	2	1923	1	1930					2	1929	1	1930	1	1931
1896	1	1925	1	1929					1	1932	3	1933	1	1939
1897	3	1923						1911	3	1913	1	1923	6	1924
1898	1	1911	1	1938					1	1926	6	1927	4	1928
1902	1	1930							4	1931	1	1932	1	1940
1903	3	1924						1912	5	1924	1	1927	2	1930
1904	4	1923	1	1924	1	1927			4	1931	2	1932	1	1937
	1	1931	1	1933				1913	1	1923	8	1924	1	1927
1905	7	1924	2	1925	1	1930			2	1928	2	1930	4	1931
	1	1932	1	1926				1914	1	1920	1	1931	1	1936
1906	1	1923	6	1924	1	1927			1	1940				
	1	1929	1	1933	1	1937		1915	1	1926	2	1940		
	2	1939						1916	1	1927	1	1931	1	1940
1907	1	1922	1	1923	2	1931		1917	3	1924	1	1927	2	1931
	3	1939						1918	2	1931				
1908	1	1924	2	1927	4	1930		1919	1	1925	1	1926	1	1931
	3	1931	1	1936					1	1934				
1909	1	1923	3	1924	2	1925		1920	2	1925	1	1926	1	1928
	5	1926	2	1927	5	1928			2	1929	1	1931	2	1932
									1	1937				

2-IN. VALVES (contd.)

Retirements by Years (contd.)

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1921	1	1923	1	1925	2	1926	1925	2	1927	3	1928	4	1929
	6	1927	8	1928	1	1929		4	1931	4	1932	1	1933
	3	1930	9	1931	1	1932		1	1934	2	1937	1	1938
	1	1933	3	1939	3	1940		1	1939				
1922	4	1923	3	1924	6	1925	1926	2	1929	1	1930	1	1936
	2	1926	14	1927	13	1928		1	1937	5	1940		
	1	1929	5	1930	14	1931	1927	1	1928	1	1930	1	1939
	8	1932	2	1935	1	1937	1928	1	1929	1	1930	2	1931
	3	1939						3	1932	1	1938		
1923	1	1924	7	1925	1	1926	1929	1	1935	1	1939		
	11	1927	12	1928	2	1929	1930	1	1930				
	3	1930	8	1931	3	1933	1931	2	1938	1	1939		
	1	1937	7	1939	4	1940	1932	1	1938	1	1939		
1924	1	1926	4	1927	2	1928	1936	1	1937				
	3	1929	4	1930	9	1931	1938	1	1939				
	2	1932	2	1935	1	1937	1939	2	1939				
	2	1938	2	1939	6	1940							

2½-IN. VALVES

<i>Year Installed</i>	<i>Number</i>			<i>Retirements by Years</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Year Installed</i>	<i>Number</i>	<i>Year</i>
1907	1	1	0	1911	1	1924
1911	1	0	1			
1939	1	1	0			
1940	0	0	0			
TOTAL	3	2	1			

3-IN. VALVES

<i>Year Installed</i>	<i>Number</i>			<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	14	0	14	1927	51	42	9
1890	1	0	1	1928	91	76	15
1891	2	0	2	1929	46	35	11
1892	1	0	1	1930	47	36	11
1895	2	2	0	1931	16	12	4
1897	1	0	1	1932	20	19	1
1912	1	1	0	1933	15	15	0
1917	1	1	0	1934	14	13	1
1919	1	0	1	1935	22	19	3
1920	1	0	1	1936	37	33	4
1921	4	4	0	1937	37	36	1
1922	17	11	6	1938	31	30	1
1923	63	35	28	1939	34	33	1
1924	78	59	19	1940	35	34	1
1925	60	47	13				
1926	40	29	11	TOTAL	783	622	161

SURVIVAL AND RETIREMENT

3-IN. VALVES (contd.)

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1881	1	1912	1	1913	1	1927		2	1940				
	2	1928	4	1929	3	1934	1927	1	1928	3	1931	1	1932
	1	1938	1	1939				2	1934	1	1936	1	1937
1890	1	1916					1928	1	1929	2	1930	3	1931
1891	2	1924						4	1932	1	1935	1	1937
1892	1	1924						1	1938	1	1939	1	1940
1897	1	1924					1929	2	1930	3	1931	2	1932
1919	1	1931						1	1935	1	1937	2	1940
1920	1	1925					1930	1	1930	3	1932	2	1933
1922	1	1925	1	1927	1	1929		2	1937	1	1938	1	1939
	3	1932						1	1940				
1923	5	1925	1	1926	10	1927	1931	1	1933	1	1936	1	1938
	3	1928	3	1931	5	1932		1	1939				
	1	1940					1932	1	1932				
1924	4	1925	4	1928	3	1930	1934	1	1937				
	5	1931	1	1932	1	1933	1935	1	1937	1	1939	1	1940
	1	1940					1936	3	1937	1	1940		
1925	1	1925	3	1927	1	1928	1937	1	1937				
	2	1931	2	1933	2	1937	1938	1	1940				
	2	1940					1939	1	1939				
1926	1	1927	2	1931	6	1932	1940	1	1940				

4-IN. VALVES

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1881	1	0	1	1915	1	0	1
1883	2	0	2	1916	8	6	2
1888	14	7	7	1917	1	0	1
1889	12	0	12	1918	5	5	0
1890	144	118	26	1919	9	9	0
1891	178	113	65	1920	2	2	0
1892	41	11	30	1921	10	10	0
1893	61	40	21	1922	20	18	2
1894	40	22	18	1923	9	7	2
1895	4	2	2	1924	15	13	2
1896	17	5	12	1925	7	6	1
1897	7	5	2	1926	4	4	0
1898	7	7	0	1927	12	10	2
1899	15	3	12	1928	13	13	0
1900	17	17	0	1929	6	6	0
1901	43	36	7	1930	11	8	3
1902	19	16	3	1931	8	8	0
1903	7	6	1	1932	4	4	0
1904	17	5	12	1934	1	1	0
1905	8	7	1	1935	2	2	0
1906	20	12	8	1936	1	1	0
1907	38	30	8	1937	1	1	0
1908	1	0	1	1938	2	2	0
1909	4	1	3	1939	3	3	0
1910	8	6	2	1940	4	4	0
1911	42	38	4				
1913	13	13	0	TOTAL	943	666	277
1914	4	3	1				

4-IN. VALVES (contd.)

Retirements by Years

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year</i>	<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1881	1	1927						1899	6	1906	3	1912	2	1929
1883	2	1926							1	1930				
1888	3	1915	1	1925	2	1926		1901	2	1912	1	1916	1	1926
	1	1934							3	1928				
1889	1	1909	2	1911	1	1922		1902	2	1916	1	1925		
	7	1928	1	1934				1903	1	1931				
1890	1	1911	1	1912	1	1913		1904	1	1923	11	1931		
	1	1916	4	1924	1	1925		1905	1	1927				
	3	1927	5	1928	2	1929		1906	1	1916	2	1924	1	1928
	2	1930	2	1931	2	1934			1	1930	1	1931	2	1939
	1	1936						1907	1	1915	1	1924	6	1934
1891	1	1909	1	1916	4	1918		1908	1	1932				
	10	1924	1	1926	18	1927		1909	3	1926				
	2	1928	1	1929	7	1930		1910	1	1916	1	1932		
	7	1931	8	1932	2	1934		1911	1	1924	1	1925	2	1931
	3	1940						1914	1	1940				
1892	6	1911	4	1923	4	1924		1915	1	1926				
	15	1930	1	1937				1916	1	1922	1	1931		
1893	10	1930	1	1931	4	1932		1917	1	1928				
	1	1933	1	1937	1	1938		1922	2	1932				
	3	1940						1923	1	1928	1	1932		
1894	2	1922	2	1925	14	1928		1924	1	1928	1	1939		
1895	2	1928						1925	1	1928				
1896	1	1924	3	1927	7	1929		1927	1	1931	1	1937		
	1	1939						1930	2	1931	1	1939		
1897	2	1939												

6-IN. VALVES

<i>Year</i>	<i>Number</i>			<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1880	10	8	2	1898	4	4	0
1881	10	8	2	1899	53	52	1
1883	15	11	4	1900	45	44	1
1884	5	5	0	1901	214	204	10
1885	20	20	0	1902	120	108	12
1886	12	12	0	1903	80	74	6
1888	51	49	2	1904	75	70	5
1889	50	46	4	1905	65	63	2
1890	784	662	122	1906	118	114	4
1891	485	449	36	1907	120	117	3
1892	500	457	43	1908	35	34	1
1893	22	20	2	1909	32	32	0
1894	24	22	2	1910	90	88	2
1895	211	178	33	1911	123	111	12
1896	36	27	9	1912	87	79	8
1897	29	29	0	1913	122	118	4

SURVIVAL AND RETIREMENT

6-IN. VALVES (contd.)

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1914	23	23	0	1929	72	72	0
1915	15	15	0	1930	98	92	6
1916	107	104	3	1931	95	95	0
1917	15	15	0	1932	42	42	0
1918	9	9	0	1933	11	11	0
1919	48	46	2	1934	5	5	0
1920	9	8	1	1935	38	38	0
1921	30	25	5	1936	29	29	0
1922	151	149	2	1937	54	54	0
1923	111	102	9	1938	32	32	0
1924	262	252	10	1939	72	72	0
1925	84	80	4	1940	74	74	0
1926	74	72	2				
1927	158	155	3	TOTAL	5,475	5,096	379
1928	110	110	0				

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1880	2	1932						1901	2	1912	1	1923	4	1924
1881	1	1934	1	1938					1	1931	1	1932	1	1937
1883	3	1914	1	1917				1902	5	1907	1	1913	4	1927
1888	1	1920	1	1935					1	1933	1	1937		
1889	4	1925						1903	1	1910	1	1923	1	1924
1890	33	1902	23	1903	2	1904			1	1929	2	1932		
	1	1905	6	1907	6	1910		1904	1	1924	1	1929	3	1931
	1	1916	2	1917	1	1921		1905	1	1928	1	1931		
	17	1922	2	1923	2	1926		1906	1	1927	1	1935	2	1940
	3	1927	4	1929	6	1931		1907	2	1929	1	1931		
	1	1933	1	1934	1	1935		1908	1	1916				
	1	1936	1	1937	7	1938		1910	1	1927	1	1931		
	1	1939						1911	2	1912	5	1924	4	1926
1891	2	1905	3	1907	2	1915			1	1931				
	3	1917	2	1918	2	1923		1912	2	1924	1	1927	4	1930
	4	1924	2	1926	1	1936			1	1932				
	1	1938	14	1940				1913	4	1931				
1892	21	1901	5	1904	2	1906		1916	2	1928	1	1937		
	1	1911	3	1922	2	1923		1919	1	1924	1	1927		
	2	1926	6	1930	1	1938		1920	1	1939				
1893	1	1925	1	1938				1921	4	1931	1	1940		
1894	2	1923						1922	1	1928	1	1929		
1895	3	1907	2	1908	5	1913		1923	1	1927	1	1928	2	1931
	2	1922	8	1923	1	1926			3	1932	2	1940		
	2	1927	3	1932	3	1933		1924	2	1928	1	1930	4	1931
	4	1937							3	1939				
1896	1	1908	8	1939				1925	1	1930	1	1932	2	1940
1899	1	1927						1926	1	1931	1	1932		
1900	1	1912						1927	1	1928	2	1931		
								1930	1	1932	1	1939	4	1940

8-IN. VALVES

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1883	12	11	1	1915	1	1	0
1884	3	3	0	1916	1	1	0
1888	1	1	0	1918	5	5	0
1889	16	16	0	1920	6	6	0
1890	246	226	20	1921	3	3	0
1891	119	109	10	1922	15	13	2
1892	12	11	1	1923	4	4	0
1893	13	13	0	1924	24	24	0
1894	2	2	0	1925	3	3	0
1895	64	60	4	1926	20	19	1
1896	4	4	0	1927	29	29	0
1897	1	1	0	1928	50	49	1
1899	1	1	0	1929	13	12	1
1900	1	1	0	1930	56	54	2
1901	5	5	0	1931	147	147	0
1902	1	1	0	1932	92	92	0
1903	6	6	0	1933	17	17	0
1904	1	0	1	1934	16	16	0
1905	8	7	1	1935	3	2	1
1906	4	4	0	1936	27	27	0
1907	13	13	0	1937	12	12	0
1908	3	2	1	1938	34	34	0
1910	10	10	0	1939	95	95	0
1911	5	5	0	1940	77	77	0
1912	4	4	0				
1913	4	4	0	TOTAL	1,311	1,264	47
1914	2	2	0				

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1883	1	1934						1904	1	1931				
1890	1	1902	1	1906	1	1907		1905	1	1928				
	1	1910	1	1911	1	1916		1908	1	1923				
	7	1922	2	1924	2	1926		1922	2	1926				
	1	1932	1	1938	1	1940		1926	1	1931				
1891	1	1904	3	1918	1	1922		1928	1	1931				
	1	1924	4	1931				1929	1	1931				
1892	1	1904						1930	1	1938	1	1940		
1895	1	1904	1	1927	1	1928		1935	1	1939				
	1	1933												

10-IN. VALVES

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1890	103	91	12	1894	10	10	0
1891	35	32	3	1895	17	17	0
1893	7	5	2	1899	2	2	0

SURVIVAL AND RETIREMENT

10-IN. VALVES (contd.)

Year	Number			Year	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1900	2	2	0	1932	1	1	0
1901	10	9	1	1935	3	3	0
1903	2	1	1	1937	1	0	1
1906	3	3	0	1939	1	1	0
1910	1	1	0	1940	2	2	0
1911	2	2	0				
1912	10	10	0	TOTAL	263	239	24
1914	1	1	0				
1915	4	4	0				
1916	2	2	0				
1917	1	1	0				
1920	7	4	3				
1921	1	1	0				
1922	12	12	0				
1923	4	4	0				
1924	8	8	0				
1925	2	2	0				
1927	5	5	0				
1928	1	1	0				
1929	1	1	0				
1930	2	1	1				

Retirements by Years						
Year	Num-	Year	Num-	Year	Num-	Year
Installed	ber	Year	ber	Year	ber	Year
1890	3	1902	2	1903	2	1908
	2	1910	2	1922	1	1938
1891	2	1918	1	1935		
1893	2	1904				
1901	1	1935				
1903	1	1934				
1920	3	1937				
1930	1	1940				
1937	1	1939				

12-IN. VALVES

Year	Number			Year	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1883	5	5	0	1916	30	27	3
1884	4	4	0	1917	10	5	5
1888	6	6	0	1918	10	10	0
1889	10	10	0	1919	16	16	0
1890	110	93	17	1920	12	12	0
1891	50	47	3	1921	1	0	1
1892	260	232	28	1922	32	32	0
1894	3	0	3	1923	55	52	3
1895	16	15	1	1924	133	133	0
1896	3	3	0	1925	14	13	1
1897	1	1	0	1926	15	13	2
1898	5	4	1	1927	71	70	1
1899	3	3	0	1928	63	63	0
1901	30	27	3	1929	35	35	0
1902	17	17	0	1930	84	81	3
1903	5	5	0	1931	105	104	1
1904	20	20	0	1932	85	85	0
1905	1	1	0	1933	2	2	0
1906	7	7	0	1934	1	1	0
1907	66	66	0	1935	1	0	1
1908	20	19	1	1936	10	10	0
1910	44	44	0	1937	28	28	0
1911	75	70	5	1938	44	42	2
1912	32	32	0	1939	87	87	0
1913	24	24	0	1940	51	51	0
1914	2	2	0				
1915	6	5	1	TOTAL	1,820	1,734	86

12-IN. VALVES (contd.)

Retirements by Years

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1890	11	1903	2	1921	1	1925			1916	2	1919	1	1936	
	1	1926	1	1927	1	1929			1917	2	1923	1	1927	2 1939
1891	2	1925	1	1933					1921	1	1940			
1892	14	1902	13	1903	1	1910			1923	3	1930			
1894	3	1924							1925	1	1932			
1895	1	1927							1926	1	1929	1	1938	
1898	1	1913							1927	1	1933			
1901	3	1925							1930	1	1931	2	1940	
1908	1	1927							1931	1	1940			
1911	5	1933							1935	1	1939			
1915	1	1931							1938	2	1940			

14-IN. VALVES

<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1890	40	36	4
1891	14	14	0
1892	2	2	0
1893	1	1	0
1894	2	0	2
1895	2	1	1
1898	1	1	0
1901	2	2	0
1908	1	0	1
1910	1	1	0
1916	1	0	1
1918	2	2	0
1920	2	2	0
1924	2	2	0
1928	1	1	0
1940	0	0	0
TOTAL	74	65	9

Retirements by Years

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1890	2	1902	1	1911	1	1932
1894	2	1932				
1895	1	1925				
1908	1	1939				
1916	1	1925				

15-IN. VALVES

<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1872	3	3	0
1890	5	5	0
1940	0	0	0
TOTAL	8	8	0

16-IN. VALVES

<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1890	44	38	6
1891	13	12	1
1894	4	4	0
1895	5	5	0
1899	2	2	0
1901	1	1	0
1903	6	6	0
1904	1	1	0
1906	1	1	0
1907	4	4	0
1908	6	6	0
1910	1	1	0
1915	3	3	0
1918	4	4	0
1919	6	6	0
1920	5	5	0
1922	1	1	0
1923	16	16	0
1924	5	5	0
1925	1	1	0
1926	3	3	0
1927	4	2	2
1929	1	0	1
1931	4	4	0
1934	1	1	0
1937	2	2	0
1940	6	6	0
TOTAL	150	140	10

Retirements by Years

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1890	3	1902	2	1904	1	1917
1891	1	1913				
1927	1	1929	1	1933		
1929	1	1939				

SURVIVAL AND RETIREMENT

18-IN. VALVES

Year	Number			Year	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1890	22	22	0	1937	1	1	0
1891	3	3	0	1940	0	0	0
1893	1	1	0				
1906	1	1	0	TOTAL	42	41	1
1908	1	1	0				
1924	5	5	0	Retirements by Years			
1925	3	3	0	Year		Year	
1927	2	1	1	Installed	Number		
1931	3	3	0	1927	1	1937	

20-IN. VALVES

Year	Number			Year	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1881	4	2	2	1928	1	1	0
1888	1	1	0	1937	2	2	0
1889	1	1	0	1938	2	2	0
1890	1	1	0	1940	0	0	0
1891	1	1	0				
1895	2	1	1	TOTAL	48	43	5
1899	4	3	1				
1903	2	2	0	Retirements by Years			
1908	1	0	1	Year		Year	
1920	10	10	0	Installed	Number	Number	Year
1923	1	1	0	1881	1	1932	1
1924	8	8	0	1895	1	1925	
1925	3	3	0	1899	1	1937	
1926	4	4	0	1908	1	1940	

24-IN. VALVES

Year	Number			Year	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1890	14	14	0	1929	1	0	1
1891	1	1	0	1930	2	0	2
1892	16	15	1	1932	4	4	0
1893	1	1	0	1933	3	3	0
1895	2	2	0	1936	1	1	0
1896	1	1	0	1937	1	1	0
1901	7	6	1	1938	14	14	0
1903	2	2	0	1939	5	5	0
1908	5	4	1	1940	3	3	0
1910	8	8	0				
1911	2	1	1	TOTAL	150	143	7
1913	2	2	0				
1914	2	2	0	Retirements by Years			
1917	1	1	0	Year		Year	
1918	5	5	0	Installed	Number	Number	Year
1920	1	1	0	1892	1	1906	
1923	13	13	0	1901	1	1928	
1924	13	13	0	1908	1	1925	
1925	2	2	0	1911	1	1923	
1926	3	3	0	1929	1	1940	
1927	13	13	0	1930	1	1932	1
1928	2	2	0				1933

30-IN. VALVES			
Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1888	1	1	0
1891	2	1	1
1903	2	2	0
1912	1	1	0
1917	2	2	0
1923	10	10	0
1924	3	3	0
1925	7	7	0
1927	7	7	0
1929	1	1	0
1932	1	1	0
1933	2	2	0
1936	6	6	0
1940	0	0	0
TOTAL	45	44	1

Retirements by Years		
Year	Number	Year
<i>Installed</i>		
1891	1	1902

36-IN. VALVES			
Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1924	4	4	0
1925	11	11	0
1927	3	3	0
1933	2	2	0

36-IN. VALVES (contd.)			
Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1936	1	1	0
1940	1	1	0
TOTAL	22	22	0

42-IN. VALVES			
Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1924	1	1	0
1925	1	0	1
1940	2	2	0
TOTAL	4	3	1

Retirements by Years		
Year	Number	Year
<i>Installed</i>		
1925	1	1937

48-IN. VALVES			
Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	2	2	0
1933	2	2	0
1940	0	0	0
TOTAL	4	4	0

HYDRANTS AND APPURTENANCES

4-IN. HYDRANTS

4-IN. HYDRANTS			
Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	1	0	1
1889	19	0	19
1890	100	57	43
1891	91	58	33
1892	40	25	15
1893	85	54	31
1894	90	54	36
1895	6	2	4
1896	4	2	2
1897	1	1	0
1899	8	5	3
1900	1	0	1
1901	27	12	15
1902	14	9	5

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1903	2	0	2
1904	1	1	0
1905	5	5	0
1906	15	5	10
1907	6	4	2
1909	2	2	0
1910	1	1	0
1911	28	26	2
1912	2	1	1
1913	1	1	0
1915	10	9	1
1916	1	1	0
1917	1	0	1
1918	1	0	1

SURVIVAL AND RETIREMENT

4-IN. HYDRANTS (contd.)

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1919	3	0	3	1929	2	2	0
1921	1	0	1	1930	14	14	0
1922	1	0	1	1931	5	4	1
1923	2	0	2	1932	2	2	0
1924	1	0	1	1936	1	1	0
1925	5	2	3	1938	1	1	0
1926	2	2	0	1940	3	3	0
1927	2	1	1				
1928	4	2	2	TOTAL	612	369	243

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1885	1	1909						1896	2	1926				
1889	1	1911	2	1915	1	1922		1899	3	1928				
	1	1923	1	1926	2	1927		1900	1	1927				
	4	1928	5	1932	2	1936		1901	1	1923	3	1925	1	1928
1890	7	1915	1	1922	3	1923			1	1929	1	1930	5	1931
	1	1925	1	1926	4	1927			1	1932	1	1933	1	1938
	5	1928	11	1930	2	1931		1902	3	1931	1	1932	1	1937
	5	1932	1	1934	1	1939		1903	1	1919	1	1923		
	1	1940						1906	4	1930	1	1938	5	1939
1891	3	1918	7	1924	1	1927		1907	1	1932	1	1939		
	1	1928	6	1931	3	1932		1911	1	1928	1	1933		
	1	1933	5	1934	1	1935		1912	1	1928				
	1	1936	1	1937	3	1940		1915	1	1928				
1892	1	1906	3	1923	2	1927		1917	1	1928				
	4	1929	2	1930	3	1931		1918	1	1936				
1893	1	1915	1	1923	1	1926		1919	3	1927				
	6	1927	4	1928	1	1929		1921	1	1929				
	10	1930	2	1931	1	1932		1922	1	1930				
	1	1937	1	1938	2	1940		1923	1	1924	1	1931		
1894	4	1922	4	1923	1	1924		1924	1	1932				
	1	1925	2	1926	9	1928		1925	1	1928	1	1932	1	1940
	1	1929	2	1930	6	1931		1927	1	1928				
	3	1932	2	1939	1	1940		1928	2	1940				
1895	2	1923	1	1929	1	1936		1931	1	1940				

6-IN. HYDRANTS

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1889	251	250	1	1899	35	34	1
1890	557	535	22	1900	14	14	0
1891	1,116	1,061	55	1901	179	176	3
1892	9	6	3	1902	93	91	2
1893	17	14	3	1903	20	19	1
1894	46	34	12	1904	31	31	0
1895	143	140	3	1905	42	41	1
1896	19	19	0	1906	97	92	5
1897	4	4	0	1907	80	77	3
1898	3	3	0	1908	8	8	0

6-IN. HYDRANTS (contd.)

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1909	5	5	0	1926	34	34	0
1910	11	11	0	1927	114	113	1
1911	30	30	0	1928	108	107	1
1912	3	3	0	1929	80	78	2
1913	41	40	1	1930	106	105	1
1914	4	4	0	1931	159	158	1
1915	7	7	0	1932	122	122	0
1916	13	12	1	1933	15	15	0
1917	15	15	0	1934	8	8	0
1918	6	5	1	1935	13	13	0
1919	24	23	1	1936	24	24	0
1920	10	9	1	1937	21	20	1
1921	41	39	2	1938	17	17	0
1922	110	109	1	1939	34	34	0
1923	98	96	2	1940	23	23	0
1924	156	156	0				
1925	82	82	0	TOTAL	4,298	4,166	132

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1889	1	1915						1903	1	1938				
1890	1	1906	2	1915	2	1923		1905	1	1928				
	1	1927	2	1929	3	1930		1906	1	1928	1	1930	1	1931
	3	1931	1	1932	1	1935			1	1937	1	1940		
	1	1936	1	1937	1	1938		1907	1	1926	1	1929	1	1940
	3	1939						1913	1	1913				
1891	3	1914	1	1915	1	1923		1916	1	1932				
	3	1926	4	1927	1	1929		1918	1	1930				
	3	1930	4	1931	5	1932		1919	1	1927				
	5	1933	4	1935	1	1936		1920	1	1937				
	6	1937	6	1938	4	1939		1921	1	1930	1	1931		
	4	1940						1922	1	1927				
1892	1	1927	1	1930	1	1935		1923	1	1927	1	1939		
1893	1	1923	1	1932	1	1937		1927	1	1939				
1894	8	1922	1	1928	1	1932		1928	1	1940				
	1	1937	1	1938				1929	1	1937	1	1940		
1895	1	1933	1	1937	1	1938		1930	1	1939				
1899	1	1930						1931	1	1933				
1901	1	1923	1	1931	1	1935		1937	1	1940				
1902	1	1929	1	1933										

4-IN. CAST-IRON HYDRANT BRANCHES

Year Installed	Feet			Year Installed	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1889	270	131	139	1895	66	34	32
1890	600	445	155	1896	36	4	32
1891	1,089	832	257	1897	24	24	0
1892	800	623	177	1898	10	10	0
1893	492	143	349	1899	86	35	51
1894	1,500	955	545	1900	225	188	37

SURVIVAL AND RETIREMENT

4-IN. CAST-IRON HYDRANT BRANCHES (contd.)

Year Installed	Feet			Year Installed	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1901	323	202	121	1921	12	4	8
1902	175	128	47	1922	8	8	0
1903	49	41	8	1923	48	14	34
1904	51	51	0	1924	21	15	6
1905	48	48	0	1925	42	6	36
1906	197	106	91	1927	18	18	0
1907	92	71	21	1928	78	78	0
1909	6	6	0	1929	4	4	0
1911	70	64	6	1930	44	44	0
1912	30	30	0	1931	5	5	0
1915	12	12	0	1937	42	42	0
1916	24	24	0	1940	3	3	0
1917	8	0	8				
1919	25	0	25	TOTAL	6,633	4,448	2,185

Retirements by Years

Year						Year					
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year
1889	25	1923	6	1926	24	1927	1896	28	1926	4	1933
	4	1928	54	1932	26	1936	1899	51	1928		
1890	36	1923	40	1927	24	1928	1900	37	1928		
	9	1931	23	1932	23	1937	1901	35	1923	39	1925
1891	86	1924	12	1927	8	1932		25	1931	12	1932
	51	1934	23	1935	5	1936	1902	26	1931	9	1932
	14	1937	8	1939	50	1940	1903	8	1923		
1892	83	1923	18	1928	41	1930	1906	37	1930	54	1939
	24	1931	11	1932			1907	10	1932	11	1939
1893	32	1923	4	1926	63	1927	1911	6	1928		
	85	1928	29	1929	86	1930	1917	8	1928		
	9	1931	6	1932	12	1937	1919	25	1927		
	4	1938	19	1940			1921	8	1929		
1894	148	1922	34	1923	10	1924	1923	24	1924	10	1931
	9	1925	22	1926	106	1928	1924	6	1932		
	46	1931	51	1932	88	1938	1925	7	1928	10	1930
	31	1939						9	1940	10	1932
1895	25	1923	7	1929							

6-IN. CAST-IRON HYDRANT BRANCHES

Year Installed	Feet			Year Installed	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1889	2,012	2,004	8	1901	1,284	1,207	77
1890	6,191	5,824	367	1902	1,065	1,042	23
1891	17,076	16,073	1,003	1903	439	429	10
1892	94	60	34	1904	354	354	0
1893	242	187	55	1905	323	258	65
1894	552	530	22	1906	1,112	997	115
1895	1,878	1,769	109	1907	811	736	75
1896	144	95	49	1908	74	74	0
1897	46	46	0	1909	57	57	0
1898	156	156	0	1910	151	85	66
1899	486	453	33	1911	309	309	0
1900	235	235	0	1912	22	22	0

6-IN. CAST-IRON HYDRANT BRANCHES (contd.)

Year				Year			
		Feet				Feet	
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1913	1,064	1,020	44	1928	1,141	1,141	0
1914	323	323	0	1929	784	784	0
1915	216	216	0	1930	1,069	1,058	11
1916	123	123	0	1931	1,899	1,899	0
1917	411	411	0	1932	1,292	1,247	45
1918	59	56	3	1933	42	42	0
1919	182	166	16	1934	167	167	0
1920	121	102	19	1935	83	83	0
1921	379	379	0	1936	297	297	0
1922	1,224	1,190	34	1937	285	285	0
1923	1,098	1,043	55	1938	241	241	0
1924	1,771	1,745	26	1939	534	534	0
1925	952	952	0	1940	452	452	0
1926	531	531	0				
1927	1,447	1,442	5	TOTAL	53,300	50,931	2,369

Retirements by Years

Year							Year						
		Feet							Feet				
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1889	8	1932					1901	40	1924	18	1927	10	1931
1890	60	1914	41	1915	6	1917		9	1939				
	6	1922	90	1923	8	1925	1902	23	1927				
	33	1927	22	1928	22	1931	1903	10	1932				
	31	1932	12	1934	14	1938	1905	53	1914	12	1928		
	22	1940					1906	69	1914	12	1917	9	1926
1891	18	1913	74	1914	29	1915		4	1927	7	1931	14	1937
	19	1917	67	1918	9	1921	1907	52	1926	23	1929		
	97	1924	68	1925	95	1926	1910	55	1920	11	1931		
	133	1927	61	1928	80	1930	1913	30	1914	14	1940		
	100	1931	45	1932	6	1933	1918	3	1936				
	16	1937	57	1938	20	1939	1919	16	1927				
	9	1940					1920	19	1937				
1892	34	1926					1922	8	1924	7	1925	9	1930
1893	8	1914	32	1923	15	1926		10	1931				
1894	15	1928	7	1932			1923	23	1926	22	1927	10	1932
1895	8	1914	60	1915	8	1920	1924	10	1927	16	1934		
	30	1922	3	1926			1927	5	1928				
1896	27	1924	22	1939			1930	11	1939				
1899	16	1928	17	1930			1932	45	1934				

4-IN. HYDRANT VALVES

Year				Year			
		Number				Number	
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1889	8	0	8	1896	4	2	2
1890	61	39	22	1897	1	1	0
1891	60	41	19	1899	9	6	3
1892	9	0	9	1900	17	13	4
1893	41	17	24	1901	36	27	9
1894	42	8	34	1902	15	11	4
1895	14	11	3	1903	2	2	0

SURVIVAL AND RETIREMENT

4-IN. HYDRANT VALVES (contd.)

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1904	10	8	2	1923	3	1	2
1905	4	4	0	1924	7	4	3
1906	21	12	9	1925	5	2	3
1907	22	17	5	1926	2	2	0
1908	2	2	0	1927	1	0	1
1909	1	1	0	1928	4	4	0
1910	8	8	0	1929	4	3	1
1911	33	32	1	1930	11	10	1
1912	4	3	1	1931	2	2	0
1913	1	1	0	1932	4	4	0
1915	10	10	0	1934	1	1	0
1916	6	5	1	1937	1	1	0
1917	1	0	1	1938	1	1	0
1919	5	2	3	1940	0	0	0
1921	1	0	1				
1922	4	3	1	TOTAL	498	321	177

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1889	1	1911	2	1923	1	1926		1900	1	1928	2	1932	1	1936
	1	1927	1	1928	2	1932		1901	1	1923	3	1925	1	1928
1890	1	1916	2	1923	1	1925			2	1931	1	1932	1	1937
	4	1927	2	1928	12	1930		1902	2	1931	1	1932	1	1937
1891	1	1916	3	1918	2	1924		1904	1	1928	1	1932		
	1	1927	1	1930	2	1932		1906	4	1930	5	1939		
	5	1934	1	1935	1	1936		1907	2	1931	3	1932		
	2	1940						1911	1	1928				
1892	1	1906	1	1923	2	1928		1912	1	1928				
	4	1930	1	1931				1916	1	1928				
1893	1	1923	6	1927	4	1928		1917	1	1928				
	1	1929	7	1930	1	1931		1919	3	1927				
	1	1932	1	1937	1	1938		1921	1	1929				
	1	1940						1922	1	1930				
1894	3	1922	4	1923	1	1924		1923	1	1924	1	1931		
	1	1925	2	1926	8	1928		1924	1	1926	1	1927	1	1932
	1	1930	6	1931	3	1932		1925	1	1928	1	1932	1	1940
	2	1938	3	1939				1927	1	1931				
1895	1	1929	1	1932	1	1933		1929	1	1931				
1896	1	1926	1	1933				1930	1	1934				
1899	3	1928												

6-IN. HYDRANT VALVES

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1889	251	248	3	1892	9	3	6
1890	473	445	28	1893	15	12	3
1891	976	890	86	1894	46	42	4

6-IN. HYDRANT VALVES (contd.)

<i>Year Installed</i>	<i>Number</i>			<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1895	170	160	10	1919	30	28	2
1896	22	19	3	1920	13	11	2
1897	4	4	0	1921	42	41	1
1898	5	5	0	1922	117	114	3
1899	34	22	12	1923	124	122	2
1900	18	18	0	1924	175	173	2
1901	185	176	9	1925	98	97	1
1902	95	95	0	1926	56	56	0
1903	38	37	1	1927	133	133	0
1904	44	44	0	1928	123	123	0
1905	47	45	2	1929	91	91	0
1906	109	105	4	1930	110	110	0
1907	97	94	3	1931	189	189	0
1908	8	8	0	1932	147	144	3
1909	7	7	0	1933	13	13	0
1910	24	24	0	1934	21	21	0
1911	30	30	0	1935	10	10	0
1912	3	3	0	1936	27	27	0
1913	73	71	2	1937	28	28	0
1914	20	20	0	1938	29	29	0
1915	7	7	0	1939	31	31	0
1916	13	13	0	1940	34	34	0
1917	15	15	0				
1918	8	6	2	TOTAL	4,487	4,293	194

Retirements by Years

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year</i>	<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1889	2	1928	1	1932				1896	1	1933	1	1938	1	1939
1890	1	1906	1	1915	1	1917		1899	1	1926	8	1928	1	1930
	2	1923	2	1925	4	1928			1	1936	1	1938		
	1	1930	4	1931	4	1932		1901	7	1922	1	1927	1	1931
	1	1934	2	1936	1	1937		1903	1	1937				
	1	1938	3	1939				1905	1	1914	1	1928		
1891	3	1914	1	1915	1	1917		1906	1	1914	1	1931	1	1934
	1	1918	1	1923	6	1924			1	1937				
	6	1925	4	1926	7	1927		1907	1	1926	2	1929		
	12	1928	1	1929	9	1930		1913	2	1914				
	7	1931	2	1932	5	1933		1918	1	1930	1	1936		
	1	1934	2	1936	7	1937		1919	2	1927				
	7	1938	2	1939	1	1940		1920	2	1937				
1892	1	1923	3	1926	2	1933		1921	1	1927				
1893	1	1923	1	1926	1	1936		1922	1	1925	1	1930	1	1931
1894	2	1928	1	1934	1	1937		1923	1	1926	1	1927		
1895	1	1915	1	1928	3	1931		1924	1	1927	1	1934		
	2	1932	1	1935	1	1936		1925	1	1931				
	1	1937						1932	3	1934				

LEAD SERVICES

 $\frac{1}{2}$ -IN. LEAD SERVICES

Year	Number			Year	Number		
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1875	1	0	1	1890	488	333	155
1881	14	9	5	1891	783	625	158
1882	77	71	6	1892	876	681	195
1883	19	11	8	1893	772	617	155
1884	63	50	13	1894	348	276	72
1885	139	130	9	1895	364	304	60
1886	126	108	18	1896	214	161	53
1887	399	399	0	1940	0	0	0
1888	211	210	1				
1889	227	215	12	TOTAL	5,121	4,200	921

Retirements by Years

Year	Num-		Num-		Num-		Year	Num-		Num-		Num-	
Installed	ber	Year	ber	Year	ber	Year	Installed	ber	Year	ber	Year	ber	Year
1875	1	1924					1891	8	1916	5	1917	2	1918
1881	1	1907	1	1925	1	1927		4	1919	12	1920	7	1921
	1	1928	1	1930				4	1922	9	1923	6	1924
1882	1	1905	1	1911	1	1912		4	1925	3	1926	2	1927
	1	1929	1	1930	1	1937		1	1928	2	1929	3	1930
1883	1	1905	2	1913	1	1914		6	1931	1	1932	5	1933
	1	1915	1	1917	1	1918		1	1934	8	1935	2	1936
	1	1919						3	1937	1	1938	4	1939
1884	1	1903	1	1908	1	1911		1	1940				
	1	1912	1	1913	1	1917	1892	2	1906	1	1907	8	1908
	1	1921	1	1922	2	1923		6	1909	5	1910	6	1911
	2	1925	1	1926				7	1912	2	1913	3	1914
1885	1	1905	1	1917	1	1918		5	1915	11	1916	2	1917
	1	1924	1	1927	1	1930		8	1918	4	1919	9	1920
	1	1931	1	1935	1	1937		4	1921	11	1922	10	1923
1886	1	1909	3	1910	1	1914		8	1924	6	1925	5	1926
	1	1915	2	1916	1	1920		3	1927	7	1928	7	1929
	2	1922	4	1924	1	1925		7	1930	4	1931	6	1932
	1	1935	1	1937				5	1933	4	1934	5	1935
1888	1	1936						7	1936	5	1937	4	1938
1889	1	1909	1	1911	1	1917		4	1939	4	1940		
	1	1922	1	1925	1	1928	1893	2	1903	2	1906	3	1907
	1	1930	1	1932	1	1934		4	1908	2	1909	8	1910
	2	1935	1	1936				2	1911	4	1912	2	1913
1890	1	1902	1	1905	1	1906		4	1914	8	1915	2	1916
	5	1908	2	1909	3	1910		1	1917	2	1918	4	1919
	6	1911	6	1912	2	1913		4	1920	2	1921	3	1922
	3	1914	4	1915	11	1916		5	1923	7	1924	10	1925
	1	1918	4	1919	4	1920		6	1926	9	1927	3	1928
	6	1921	7	1922	7	1923		6	1929	9	1930	6	1931
	10	1924	4	1925	8	1926		5	1932	4	1933	2	1934
	4	1927	3	1928	8	1929		4	1935	2	1936	5	1937
	16	1930	7	1931	5	1932		10	1939	3	1940		
	3	1933	2	1934	5	1935	1894	3	1904	2	1905	1	1906
	2	1936	2	1937	2	1938		2	1908	2	1909	4	1910
1891	1	1907	2	1908	6	1909		3	1911	3	1912	2	1913
	9	1910	8	1911	11	1912		2	1915	2	1918	1	1919
	6	1913	2	1914	9	1915		1	1920	1	1921	4	1922

$\frac{1}{2}$ -IN. LEAD SERVICES (contd.)*Retirements by Years (contd)*

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1894	4	1923	1	1924	1	1925	1895	2	1933	2	1934	2	1935
	1	1927	3	1928	2	1929		1	1936	4	1937	2	1938
	3	1930	4	1931	2	1932		4	1939	1	1940		
	5	1933	3	1934	2	1935	1896	3	1907	5	1908	4	1909
	4	1936	1	1937	3	1938		1	1910	1	1911	4	1912
1895	2	1900	2	1903	1	1904		1	1913	2	1914	1	1915
	2	1905	3	1908	3	1910		1	1916	1	1917	1	1918
	1	1911	2	1912	1	1913		1	1922	2	1923	2	1924
	2	1914	1	1917	3	1918		2	1925	1	1927	2	1928
	1	1919	2	1920	1	1923		3	1929	3	1930	3	1931
	3	1924	2	1925	2	1926		1	1933	2	1935	1	1936
	1	1927	2	1928	2	1929		4	1937	1	1938		
	1	1930	1	1931	1	1932							

 $\frac{3}{8}$ -IN. LEAD SERVICES

<i>Year Installed</i>	<i>Number</i>			<i>Year Installed</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1875	115	106	9	1909	1,350	1,324	26
1876	85	79	6	1910	1,121	1,103	18
1877	69	64	5	1911	991	971	20
1878	190	179	11	1912	651	643	8
1879	348	326	22	1913	381	380	1
1880	414	397	17	1914	253	252	1
1881	505	477	28	1915	229	229	0
1882	354	325	29	1916	182	181	1
1883	271	251	20	1917	136	132	4
1884	183	161	22	1918	114	110	4
1885	233	212	21	1919	220	218	2
1886	236	208	28	1920	210	210	0
1887	130	130	0	1921	443	438	5
1888	1,139	1,080	59	1922	593	582	11
1889	1,538	1,417	121	1923	670	666	4
1890	2,071	1,848	223	1924	953	950	3
1891	1,363	1,139	224	1925	948	948	0
1892	1,010	899	111	1926	508	506	2
1893	700	609	91	1927	397	397	0
1894	247	222	25	1928	296	295	1
1895	372	331	41	1929	205	204	1
1896	279	252	27	1930	115	115	0
1897	360	360	0	1931	149	149	0
1898	400	400	0	1932	85	85	0
1899	615	615	0	1933	23	23	0
1900	568	512	56	1934	18	18	0
1901	953	891	62	1935	50	50	0
1902	912	852	60	1936	73	73	0
1903	889	860	29	1937	104	104	0
1904	1,030	972	58	1938	84	84	0
1905	918	843	75	1939	128	128	0
1906	1,085	1,032	53	1940	150	150	0
1907	1,060	992	68				
1908	1,189	1,163	26	TOTAL	33,661	31,922	1,739

$\frac{5}{8}$ -IN. LEAD SERVICES (contd.)

Retirements by Years

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	
1875	1	1907	2	1913	1	1915		1886	1	1916	1	1919	1	1920
	1	1919	2	1925	1	1929			2	1921	1	1922	1	1923
	1	1931							2	1924	2	1925	2	1927
1876	1	1905	1	1913	1	1924			1	1930	1	1933	1	1936
	1	1926	1	1931	1	1937			1	1938				
1877	1	1909	1	1918	1	1925		1888	2	1919	3	1920	3	1921
	2	1928							5	1922	3	1923	1	1924
1878	1	1906	1	1909	1	1912			2	1925	7	1926	3	1927
	2	1915	1	1923	2	1928			2	1928	1	1929	5	1930
	1	1931	1	1937	1	1939			8	1931	2	1933	1	1935
1879	1	1905	2	1906	1	1911			1	1937	2	1938	5	1939
	1	1912	1	1915	1	1920			3	1940				
	1	1921	1	1923	1	1925		1889	1	1907	1	1915	1	1917
	1	1928	2	1929	2	1930			12	1920	3	1921	8	1922
	3	1931	1	1933	1	1935			14	1923	3	1924	3	1925
	1	1936	1	1937					2	1926	3	1927	11	1928
1880	1	1905	2	1906	1	1908			8	1929	9	1930	11	1931
	1	1910	1	1912	1	1913			1	1932	3	1933	2	1934
	1	1924	2	1925	1	1927			5	1935	2	1937	8	1938
	1	1928	3	1932	1	1937			9	1939	1	1940		
	1	1938						1890	3	1905	3	1906	2	1907
1881	2	1905	1	1907	1	1908			3	1908	2	1909	3	1910
	1	1912	2	1913	1	1914			4	1912	5	1913	1	1914
	1	1916	2	1917	1	1919			2	1915	2	1916	2	1917
	2	1921	1	1922	2	1924			2	1919	4	1920	5	1921
	2	1925	1	1927	1	1931			16	1922	15	1923	10	1924
	4	1932	1	1934	1	1938			14	1925	14	1926	10	1927
	1	1939							6	1928	6	1929	15	1930
1882	1	1906	1	1907	1	1909			14	1931	10	1932	4	1933
	1	1911	1	1912	1	1913			7	1935	8	1936	1	1937
	1	1915	1	1923	1	1924			1	1938	9	1939	14	1940
	4	1925	2	1926	3	1927			6	1941				
	1	1928	5	1929	1	1931		1891	1	1905	3	1906	1	1907
	1	1935	1	1936	2	1937			2	1908	5	1910	4	1911
1883	1	1905	1	1913	1	1918			2	1912	2	1914	3	1915
	1	1919	2	1921	2	1924			2	1916	2	1917	3	1918
	2	1925	2	1926	2	1927			3	1919	7	1920	13	1921
	1	1929	1	1930	1	1931			7	1922	10	1923	10	1924
	1	1933	1	1938	1	1941			15	1925	14	1926	12	1927
1884	1	1905	3	1906	1	1908			6	1928	7	1929	16	1930
	2	1909	1	1910	1	1916			10	1931	4	1932	11	1933
	3	1917	1	1923	3	1924			3	1934	5	1935	7	1936
	1	1925	1	1926	1	1927			6	1937	7	1938	15	1939
	1	1930	1	1933	1	1938			5	1940	1	1941		
1885	1	1906	2	1907	2	1915		1892	1	1909	1	1913	1	1915
	1	1918	1	1919	2	1922			1	1917	1	1919	2	1920
	1	1923	1	1924	1	1925			7	1921	5	1922	4	1923
	1	1926	1	1930	2	1931			6	1924	11	1925	7	1926
	1	1932	1	1933	1	1937			7	1927	3	1928	3	1929
	1	1938	1	1939					5	1930	5	1931	5	1932
1886	1	1905	2	1906	1	1908			5	1933	2	1934	2	1936
	1	1909	1	1910	1	1911			8	1937	3	1938	10	1939
	2	1912	1	1914	1	1915			3	1940	3	1941		

½-IN. LEAD SERVICES (contd.)

Retirements by Years (contd.)

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1893	2	1905	1	1907	1	1909		1902	3	1933	3	1934	1	1935
	1	1910	1	1913	1	1915			5	1936	6	1937	5	1938
	2	1919	2	1920	1	1921			4	1939	2	1940	1	1941
	4	1922	5	1923	9	1924		1903	1	1915	1	1917	2	1922
	5	1925	8	1926	6	1927			3	1923	2	1924	1	1926
	4	1928	2	1929	7	1930			1	1928	2	1929	3	1930
	4	1931	2	1932	4	1933			2	1931	1	1932	1	1933
	3	1934	2	1935	1	1936			1	1934	2	1935	1	1936
	2	1937	5	1939	3	1940			1	1937	1	1938	1	1939
	3	1941							1	1940	1	1941		
1894	1	1910	1	1914	1	1917		1904	2	1908	1	1910	2	1911
	1	1923	2	1924	2	1926			4	1912	1	1913	1	1918
	1	1927	2	1928	1	1929			2	1920	1	1921	3	1922
	3	1930	3	1931	4	1932			3	1923	2	1924	2	1925
	1	1936	1	1937	1	1939			4	1926	3	1927	2	1929
1895	2	1905	1	1909	1	1911			3	1930	3	1931	3	1932
	2	1912	1	1919	1	1920			2	1933	1	1935	3	1936
	1	1922	1	1923	2	1924			2	1937	3	1938	4	1939
	2	1925	1	1928	2	1929			1	1940				
	1	1930	1	1932	3	1934		1905	1	1910	1	1911	3	1912
	1	1935	3	1937	4	1938			3	1918	2	1919	3	1922
	9	1939	2	1940					4	1923	6	1924	5	1925
1896	1	1905	2	1906	1	1909			1	1926	2	1927	3	1928
	1	1920	1	1921	1	1922			3	1929	5	1930	3	1933
	1	1924	1	1928	1	1929			6	1934	3	1935	2	1936
	1	1930	2	1931	5	1934			8	1937	2	1938	5	1939
	6	1935	1	1936	2	1937			3	1940	1	1941		
1900	1	1905	1	1906	1	1908		1906	1	1908	1	1911	1	1915
	1	1909	1	1910	1	1911			1	1919	1	1920	1	1922
	2	1913	1	1914	1	1916			9	1924	2	1925	2	1926
	1	1917	2	1918	4	1922			2	1927	1	1928	4	1929
	1	1923	2	1924	3	1925			6	1930	3	1932	2	1933
	3	1926	5	1927	2	1928			1	1934	1	1935	2	1936
	2	1929	4	1930	2	1931			2	1937	3	1938	4	1939
	1	1932	1	1933	1	1934			3	1940				
	1	1935	1	1936	1	1937		1907	2	1908	3	1911	2	1914
	3	1938	4	1939	1	1940			1	1923	3	1924	1	1925
	1	1941							2	1926	2	1927	3	1928
1901	1	1905	1	1906	1	1910			3	1929	4	1930	4	1931
	1	1912	1	1914	1	1917			6	1932	4	1933	3	1934
	1	1919	5	1920	2	1921			1	1935	2	1936	2	1937
	2	1922	1	1923	2	1924			5	1938	5	1939	6	1940
	1	1925	3	1927	2	1928			4	1941				
	2	1929	2	1930	4	1931		1908	1	1920	1	1923	2	1924
	6	1932	6	1933	8	1935			1	1926	3	1927	2	1928
	3	1936	2	1937	1	1938			1	1929	1	1930	2	1931
	2	1939	1	1940					3	1932	2	1935	1	1936
1902	1	1905	1	1908	2	1910			2	1937	3	1938	1	1939
	1	1911	1	1912	1	1914		1909	3	1913	1	1915	1	1923
	1	1916	1	1917	1	1920			1	1924	1	1927	1	1928
	1	1923	1	1924	1	1925			3	1929	5	1930	1	1934
	1	1926	3	1927	1	1928			1	1935	1	1937	3	1938
	3	1930	7	1931	2	1932			1	1939	3	1940		

SURVIVAL AND RETIREMENT

 $\frac{1}{2}$ -IN. LEAD SERVICES (contd.)

Retirements by Years (contd.)

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1910	1	1913	1	1921	2	1923		1917	1	1931	1	1935	1	1938
	5	1924	1	1925	1	1928			1	1939				
	1	1930	1	1931	1	1932		1918	1	1924	2	1936	1	1939
	1	1933	1	1939	2	1940		1919	1	1923	1	1925		
1911	1	1912	1	1914	1	1915		1921	1	1922	1	1926	1	1927
	6	1924	1	1926	2	1928			1	1931	1	1938		
	1	1929	2	1930	2	1935		1922	4	1924	1	1928	1	1929
	1	1936	1	1938	1	1939			1	1930	1	1938	3	1939
1912	1	1920	1	1923	1	1924		1923	1	1924	2	1930	1	1940
	1	1929	1	1930	1	1931		1924	1	1924	1	1938	1	1940
	1	1940	1	1941				1926	1	1939	1	1940		
1913	1	1923						1928	1	1938				
1914	1	1935						1929	1	1930				
1916	1	1924												

 $\frac{3}{4}$ -IN. LEAD SERVICES

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1875	14	14	0	1909	841	823	18
1876	2	2	0	1910	808	791	17
1877	6	6	0	1911	695	679	16
1878	9	8	1	1912	519	515	4
1879	23	22	1	1913	300	300	0
1880	35	34	1	1914	236	236	0
1881	31	31	0	1915	204	199	5
1882	30	30	0	1916	220	220	0
1883	17	14	3	1917	189	185	4
1884	11	10	1	1918	181	177	4
1885	18	18	0	1919	432	328	4
1886	48	44	4	1920	501	500	1
1887	49	49	0	1921	1,439	1,432	7
1888	320	256	64	1922	2,227	2,196	31
1889	418	336	82	1923	2,186	2,166	20
1890	533	383	150	1924	2,208	2,194	14
1891	341	227	114	1925	2,188	2,183	5
1892	224	146	78	1926	1,498	1,493	5
1893	163	98	65	1927	1,281	1,272	9
1894	59	35	24	1928	1,105	1,102	3
1895	120	80	40	1929	750	748	2
1896	102	67	35	1930	423	423	0
1897	71	71	0	1931	523	516	7
1898	92	92	0	1932	341	340	1
1899	134	134	0	1933	179	178	1
1900	132	122	10	1934	209	209	0
1901	251	222	29	1935	409	407	2
1902	241	227	14	1936	670	667	3
1903	275	264	11	1937	768	766	2
1904	338	327	11	1938	805	805	0
1905	391	354	37	1939	1,228	1,227	1
1906	389	364	25	1940	1,992	1,992	0
1907	475	453	22				
1908	904	885	19	TOTAL	33,821	32,794	1,027

SURVIVAL AND RETIREMENT

 $\frac{3}{4}$ -IN. LEAD SERVICES (contd.)

Retirements by Years (contd.)

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1902	1	1920	1	1921	1	1922	1911	1	1930	1	1936	1	1937
	1	1924	2	1925	1	1926		1	1939	2	1940		
	1	1928	2	1929	2	1930	1912	1	1924	1	1926	1	1935
	1	1932	1	1937				1	1939				
1903	1	1907	1	1916	2	1918	1915	2	1924	1	1925	1	1929
	1	1919	1	1922	1	1924		1	1939				
	1	1926	1	1930	2	1940	1917	1	1922	1	1926	1	1928
1904	1	1910	1	1917	2	1923		1	1938				
	1	1924	2	1926	1	1928	1918	1	1924	1	1925	2	1940
	1	1931	1	1936	1	1940	1919	1	1927	1	1934	1	1937
1905	1	1915	2	1916	3	1925		1	1938				
	1	1926	2	1927	4	1928	1920	1	1936				
	4	1929	1	1930	1	1931	1921	1	1924	1	1925	1	1929
	3	1932	3	1933	2	1934		1	1930	1	1931	1	1933
	2	1935	1	1936	2	1938		1	1938				
	3	1939	2	1940			1922	1	1923	6	1924	1	1925
1906	2	1911	2	1914	1	1922		1	1926	1	1927	1	1928
	2	1923	2	1924	2	1925		1	1929	1	1930	4	1933
	1	1927	2	1928	1	1929		3	1934	1	1935	1	1938
	2	1930	2	1933	1	1936		5	1939	4	1940		
	3	1937	1	1938	1	1940	1923	4	1924	2	1928	1	1929
1907	1	1907	1	1909	1	1913		3	1930	1	1934	4	1935
	1	1914	1	1924	2	1925		1	1936	1	1937	1	1938
	1	1926	1	1927	2	1929		2	1939				
	1	1933	3	1934	1	1935	1924	3	1924	1	1925	2	1929
	1	1936	1	1937	2	1938		2	1930	1	1932	2	1936
	2	1939						1	1937	1	1939	1	1940
1908	1	1910	1	1919	1	1922	1925	1	1926	1	1929	2	1932
	4	1924	1	1925	2	1926		1	1940				
	1	1927	1	1928	1	1929	1926	2	1928	1	1932	1	1936
	1	1931	1	1932	1	1937		1	1940				
	1	1939	2	1940			1927	1	1930	1	1931	4	1932
1909	1	1923	2	1924	1	1925		1	1937	2	1940		
	1	1927	1	1928	1	1929	1928	1	1932	1	1937	1	1938
	3	1930	2	1932	1	1933	1929	1	1933	1	1936		
	1	1935	1	1937	2	1938	1931	1	1933	1	1935	1	1936
	1	1939						1	1937	3	1938		
1910	1	1916	3	1923	1	1925	1932	1	1936				
	2	1926	1	1927	1	1929	1933	1	1940				
	1	1930	1	1933	1	1935	1935	1	1939	1	1940		
	1	1936	1	1937	2	1938	1936	1	1936	1	1938	1	1940
	1	1940					1937	2	1939				
1911	2	1922	2	1924	1	1925	1939	1	1940				
	3	1927	1	1928	1	1929							

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Year	Number			Year	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1875	1	1	0	1910	62	62	0
1877	5	5	0	1911	28	26	2
1878	6	6	0	1912	27	27	0
1880	1	1	0	1913	9	8	1
1881	5	5	0	1914	2	2	0
1882	8	8	0	1915	14	14	0
1883	6	6	0	1916	21	21	0
1884	5	5	0	1917	11	11	0
1885	18	18	0	1918	5	5	0
1886	13	13	0	1919	16	16	0
1887	15	15	0	1920	27	26	1
1888	15	7	8	1921	23	23	0
1889	98	90	8	1922	22	22	0
1890	170	153	17	1923	27	27	0
1891	94	83	11	1924	33	32	1
1892	79	58	21	1925	28	28	0
1893	69	59	10	1926	17	17	0
1894	24	13	11	1927	24	24	0
1895	31	28	3	1928	46	46	0
1896	28	23	5	1929	41	41	0
1897	3	3	0	1930	13	13	0
1898	31	31	0	1931	24	24	0
1899	65	65	0	1932	11	11	0
1900	55	51	4	1933	2	2	0
1901	106	100	6	1934	13	13	0
1902	47	45	2	1935	22	22	0
1903	67	62	5	1936	43	43	0
1904	32	29	3	1937	51	51	0
1905	35	31	4	1938	26	26	0
1906	53	48	5	1939	47	47	0
1907	51	46	5	1940	60	60	0
1908	71	69	2				
1909	62	62	0	TOTAL	2,164	2,029	135

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1888	1	1905	2	1906	1	1909	1890	1	1905	1	1906	1	1907
	1	1910	2	1915	1	1923		1	1908	1	1912	1	1914
1889	1	1910	1	1911	1	1913		1	1916	1	1917	1	1918
	1	1916	2	1920	1	1921		1	1927	1	1930	1	1932
	1	1922						5	1940				

SURVIVAL AND RETIREMENT

1-IN. LEAD SERVICES (contd.)

Retirements by Years (contd.)

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	
1891	3	1912	1	1918	1	1921		1901	1	1922	1	1928	1	1930
	1	1923	1	1926	2	1928			1	1932	1	1939	1	1940
	1	1933	1	1938				1902	1	1928	1	1938		
1892	3	1906	1	1911	2	1914		1903	1	1929	2	1932	1	1936
	1	1922	2	1924	3	1926			1	1940				
	2	1927	1	1929	1	1935		1904	1	1925	2	1932		
	3	1937	1	1938	1	1939		1905	1	1927	1	1928	1	1937
1893	2	1905	1	1913	2	1920			1	1939				
	1	1922	1	1928	1	1929		1906	1	1926	1	1927	1	1930
	2	1940							1	1934	1	1938		
1894	1	1907	1	1911	1	1918		1907	1	1926	1	1930	1	1934
	1	1921	1	1925	1	1928			2	1938				
	1	1933	1	1938	2	1939		1908	1	1932	1	1936		
	1	1940						1911	1	1922	1	1925		
1895	1	1927	1	1931	1	1933		1913	1	1935				
1896	1	1907	1	1909	1	1920		1920	1	1923				
	1	1922	1	1934				1924	1	1929				
1900	1	1921	1	1937	1	1938								
	1	1939												

1½-IN. LEAD SERVICES

<i>Year Installed</i>	<i>Number</i>			<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1887	2	2	0	1926	8	8	0
1896	1	1	0	1927	15	15	0
1898	4	4	0	1928	22	22	0
1899	4	4	0	1929	11	11	0
1900	4	4	0	1930	4	4	0
1901	12	12	0	1931	4	4	0
1902	8	6	2	1932	1	1	0
1903	19	19	0	1933	2	2	0
1904	8	7	1	1934	1	1	0
1905	10	10	0	1935	1	1	0
1906	15	10	5	1936	2	2	0
1907	8	5	3	1937	8	8	0
1908	7	7	0	1938	9	9	0
1909	15	15	0	1939	10	10	0
1910	17	16	1	1940	4	4	0
1911	6	6	0				
1912	5	5	0	TOTAL	312	300	12
1914	2	2	0				
1915	2	2	0				
1916	3	3	0				
1917	5	5	0				
1919	5	5	0				
1920	5	5	0				
1921	2	2	0				
1922	8	8	0				
1923	10	10	0				
1924	10	10	0				
1925	13	13	0				

Retirements by Years

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1902	2	1938				
1904	1	1911				
1906	1	1926	1	1935	1	1936
	1	1937	1	1938		
1907	2	1922	1	1936		
1910	1	1919				

1½-IN. LEAD SERVICES

<i>Year</i> <i>Installed</i>	<i>Number</i>			<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1888	15	15	0	1915	2	2	0
1889	27	27	0	1916	3	3	0
1890	26	26	0	1917	5	4	1
1891	21	18	3	1919	4	3	1
1892	35	34	1	1920	3	3	0
1893	21	21	0	1921	2	2	0
1894	5	5	0	1922	9	9	0
1896	4	4	0	1923	5	5	0
1897	5	5	0	1924	16	15	1
1898	10	10	0	1925	9	9	0
1899	5	5	0	1926	3	3	0
1900	30	25	5	1927	2	2	0
1901	46	46	0	1928	7	7	0
1902	29	24	5	1929	8	8	0
1903	8	7	1	1930	4	4	0
1904	3	2	1	1931	2	2	0
1905	11	9	2	1932	1	1	0
1906	6	5	1	1933	1	1	0
1907	11	11	0	1935	2	2	0
1908	12	12	0	1936	3	3	0
1909	12	10	2	1937	6	6	0
1910	13	10	3	1938	4	4	0
1911	9	8	1	1939	4	4	0
1912	3	3	0	1940	2	2	0
1913	2	2	0				
1914	4	4	0	TOTAL	480	452	28

Retirements by Years

<i>Year</i> <i>Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year</i> <i>Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1891	1	1908	1	1911	1	1927	1906	1	1927				
1892	1	1920					1909	2	1930				
1900	1	1919	1	1920	1	1927	1910	1	1929	1	1932	1	1934
	1	1932	1	1934			1911	1	1930				
1902	2	1923	1	1926	2	1936	1917	1	1933				
1903	1	1928					1919	1	1932				
1904	1	1937					1924	1	1940				
1905	1	1926	1	1938									

2-IN. LEAD SERVICES

<i>Year</i> <i>Installed</i>	<i>Number</i>			<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	1	1	0	1902	2	2	0
1882	1	1	0	1903	3	3	0
1884	1	1	0	1905	4	4	0
1887	6	6	0	1906	3	2	1
1892	17	16	1	1907	4	4	0
1893	30	29	1	1908	2	2	0
1894	8	4	4	1909	7	5	2
1896	4	4	0	1910	3	3	0
1901	2	1	1	1911	1	1	0

SURVIVAL AND RETIREMENT

2-IN. LEAD SERVICES (contd.)

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1912	2	2	0	1926	2	2	0
1913	5	5	0	1928	1	1	0
1914	1	1	0	1930	1	1	0
1917	3	3	0	1931	2	2	0
1918	1	1	0	1933	1	1	0
1919	1	1	0	1935	1	1	0
1920	3	3	0	1936	2	2	0
1921	1	1	0	1937	3	3	0
1922	2	2	0	1938	3	3	0
1923	2	2	0	1940	1	1	0
1924	5	5	0				
1925	2	2	0	TOTAL	144	134	10

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1892	1	1925						1901	1	1933				
1893	1	1924						1906	1	1917				
1894	1	1911	1	1925	1	1929		1909	1	1928	1	1932		
	1	1930												

3-IN. LEAD SERVICES

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1900	1	0	1	1938	2	2	0
1901	2	0	2	1940	1	1	0
1916	1	1	0				
1917	1	1	0	TOTAL	26	22	4
1918	2	2	0				
1919	2	1	1				
1921	2	2	0				
1922	1	1	0				
1923	3	3	0				
1924	5	5	0				
1925	2	2	0				
1931	1	1	0				

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1900	1	1928				
1901	1	1932	1	1936		
1919	1	1932				

Des Moines, Iowa

As of December 31, 1942

THE Des Moines Water Works System is a municipally-owned water plant serving the city of Des Moines, Iowa, and contiguous area. The city is the state capital and is important as a distribution, manufacturing and office center. The water plant also serves Fort Des Moines, south of the city, at present one of the Women's Army Corps' training centers. Des Moines is located at the confluence of the Des Moines and Raccoon rivers. Within the service territory at the date of the study there were 38,824 services furnishing water to an estimated 179,853 people. Consumption during 1942 averaged 15.5 mgd. or about 86 gpd. per capita.

Development of the Existing System

The Des Moines Water Works was started in 1871 by the Des Moines Water Co. and continued as a private organization until its purchase by the city in 1919. Records concerning the source and character of the original supply before 1884 are obscure. In 1884 a new supply was obtained from an infiltration gallery along the north side of the Raccoon River. It terminated in a suction well at a pumping station located at 16th and Walnut Streets. The original infiltration gallery consisted of 1,077 ft. of conduit, 4 ft. \times 5 ft. in section, constructed of wood plank surrounded by crushed stone. Additions to the original gallery were made at numerous dates, as shown in Table 5. In 1887, Gallery

No. 2 and a river well connected to it were built to secure water from the Raccoon River.

In the years 1923-1924 and 1932 the present supply was further developed on the south side of the river. Galleries 1, 2 and a part of Gallery 3, together with the suction wells and the pumping station and equipment at 16th and Walnut Streets, were abandoned in 1922. The new supply similarly consists of an infiltration gallery, constructed of concrete and steel ring sections 48 and 60 in. in diameter, set on cradles and surrounded by gravel jackets. A portion of the old wooden gallery is connected and still in service. A total of approximately 18,600 ft. of collecting gallery is in service.

Another flooding station at 28th Street, first put into service in 1918, is also used by pumping from Raccoon River for flooding a portion of the area over the collecting gallery at low stages of the river.

The four main pumping units in the old plant at 16th and Walnut Streets were steam-engine-driven, horizontal compound units installed in 1883, 1884, 1902 and 1910 and retired in 1921 upon the construction of the 21st Station. The four main units at the 21st Station installed in 1920, 1921, 1922 and 1928 are still in service.

From the pumping station the water is pumped directly into the distribution system in a single service with a 2-mil. gal. elevated tank as an equalizer. Pumping heads at the station average

TABLE 1
SUMMARY OF MAINS
DES MOINES, IOWA

Size, in.	Kind	No. of Feet Installed	No. of Feet Identified	Percentage of Total	No. of Feet Retired	Percentage of Total	No. of Feet in Service	Percentage of Total	Year of First Installation	Average Age, yr.
30	Steel	1,826	1,826	0.09	0	0	1,826	0.09	1936	6.5
12	Steel	742	742	0.04	0	0	742	0.04	1940	2.5
30		18,004	18,004	0.86	2,226	19.51	15,778	0.76	1920	10.3
24		6,409	6,409	0.31	9	0.08	6,400	0.31	1922	19.0
20		45,715	45,715	2.20	1,216	10.66	44,499	2.15	1883	17.2
16		38,431	34,403	1.65	365	3.20	34,038	1.64	1883	25.5
14	Cast-iron unlined	36,477	36,477	1.75	0	0	36,477	1.76	1941	1.5
12		188,975	185,711	8.92	370	3.24	185,341	8.96	1888	26.1
10		6,305	1,355	0.07	0	0	1,355	0.06	1896	46.5
8		1,561,267	1,488,250	71.52	4,895	42.90	1,483,355	71.68	1884	23.6
6		327,970	261,499	12.57	1,956	17.15	259,543	12.54	1881	29.5
4		18,312	501	0.02	372	3.26	129	0.01	1881	23.2
TOTAL		2,250,433	2,080,892	100.00	11,409	100.00	2,069,483	100.00		23.9
Percentage of Total			100.0		0.62		99.38			
Average Size, in.			8.87		12.68		8.84			

*Mortality Survival Ratios
Cast-Iron Unlined Pipe*

Size, in.	No. of Feet	Period Covered, yr.	Percentage
4	501	61.5	7.000
6	261,499	61.5	97.455
8	1,488,250	58.5	98.507
10-12	187,066	54.5	99.604
Over 12	141,008	59.5	81.902
TOTAL	2,078,324		

about 120 psi. There are in the distribution system, exclusive of hydrant branches, approximately 420 mi. of pipe ranging from 4 to 30 in. in diameter. The greater portion of the system consists of Class B, tar-coated, bell-and-spigot, cast-iron pipe, generally laid with a cover of 5 ft.

There are 38,824 service connections which, with the exception of the larger cast-iron services and recent copper in-

stallations, are of lead. The system has 2,863 valves, 3,665 hydrants and 38,639 meters. Of the total number of facilities installed 2,588 valves, 3,733 hydrants and 40,704 meters were identified as to the year installed. The services are approximately 100 per cent metered with 84 per cent of the total output of water billed through meters.

TABLE 2
SUMMARY OF VALVES
DES MOINES, IOWA

Size, in.	Number Installed	Number Identified	Number Retired	Number in Service	Year of First Installation	Average Age, yr.	Number Salvaged
4	59	13	0	13	1884	26.3	—
6	624	501	0	501	1881	29.3	—
8	1,891	1,791	4	1,787	1884	23.4	3
10	8	3	0	3	1896	46.5	—
12	170	164	2	162	1888	25.4	2
14	14	14	0	14	1941	1.5	—
16	37	34	3	31	1883	29.9	3
20	36	35	0	35	1883	20.4	—
24	7	7	0	7	1922	19.1	—
30	27	26	1	25	1921	12.1	1
TOTAL	2,873	2,588	10	2,578		24.5	
Percentage of Total		100.00	0.39	99.61			

NOTE: With one exception all valves shown as retired were removed, salvaged and used again. One 8-in. valve, retired because of sewer construction, was abandoned.

Mortality Survival Ratios

Size, in.	Number	Period Covered, yr.	Percentage
4	13	58.5	100.000
6	501	61.5	100.000
8	1,791	58.5	99.376
10 and 12	167	53.5	95.905
Over 12	116	59.5	86.789
TOTAL	2,588		

Basis of Study

The records of installation and retirement of pipe and valves are stated to be complete from 1912 to date. From 1871 to 1882 the footage of pipe laid is largely unknown. From plat books, field notes and other records the retirements of pipe since 1882 have been secured. Prior to 1882 the retirement date is obscure so that pipe installations made in the period from 1871 to 1882, which are still in service, have been called unidentified and have been eliminated from the mortality study. It is stated that most of

the pipe originally laid in this period is still in service. Annual reports are available from 1913 to the present date.

The records of meters and hydrants are substantially complete from 1880 to the present, as are those of pipe and valves. The installation and retirement of Class B facilities from 1882 to date could be accurately secured from the various basic records available.

The work of abstracting the records of installation and retirement of mains, valves, meters, hydrants and Class B facilities was carried out by the regular staff of the department.

TABLE 3
SUMMARY OF METERS
DES MOINES, IOWA

Size, in.	Kind	Number Installed	Number Identified	Number Retired	Number in Service	Average Age, yr.
$\frac{5}{8}$	Disc	37,505	37,493	466	37,027	23.2
$\frac{3}{4}$		303	302	4	298	16.2
1		422	422	11	411	25.5
$1\frac{1}{2}$		152	152	15	137	21.1
2		311	311	34	277	20.3
$\frac{5}{8}$	Rotary	1,896	1,853	1,610	243	44.5
$\frac{3}{4}$		68	55	55	0	—
1		26	23	23	0	—
$1\frac{1}{2}$		9	8	8	0	—
2		40	39	39	0	—
3	Proportion	3	3	3	0	—
4		2	1	1	0	—
3		6	6	1	5	23.1
4		5	5	5	0	—
6		5	5	4	1	25.5
3	Torrent	5	5	2	3	33.8
4		6	6	3	3	36.5
6		4	4	2	2	34.5
3	Compound	2	2	0	2	25.5
4		3	3	0	3	22.2
6		6	6	1	5	2.9
TOTAL		40,779	40,704	2,287	38,417	23.3

Mortality Survival Ratios

Size, in.	Kind	Number	Period Covered, yr.	Percentage
$\frac{5}{8}$	Disc	37,493	52.5	91.344
$\frac{3}{4}$	Rotary	1,853	60.5	3.267
$\frac{3}{4}$	Disc	1,187	42.5	89.136
$\frac{3}{4}$	Rotary	129	53.5	0
Others		42	46.5	0
TOTAL		40,704		

TABLE 4
SUMMARY OF HYDRANTS
DES MOINES, IOWA

Number Installed	Number Identified	Number Retired	Number in Service	Average Age, yr.	Period Covered, yr.	Mortality Survival Ratio, %
4,061	3,733	279	3,454	24.3	61.5	68.036

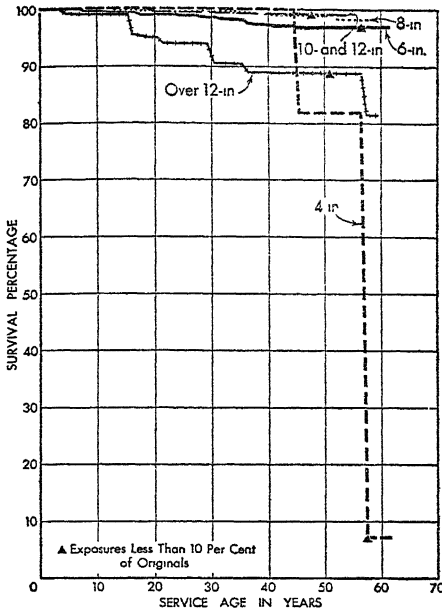


FIG. 1. Mortality Survival Curve—4-30-in. Cast-Iron Unlined Mains—Des Moines, Iowa

BASE: Feet		SURVIVAL: 1881-1942	
SIZE	EXPOSURES	RETIREMENTS	
<i>in.</i>	<i>ft.</i>	<i>ft.</i>	
4	501	372	
6	261,499	1,956	
8	1,488,250	4,895	
10 and 12	187,066	370	
Over 12	141,008	3,816	

Mortality Survival Study

Mortality studies were made of mains, valves, meters and hydrants. Table 1 is a summary of the pipe installed, the amount identified, retirements of identified pipe and pipe still in service, as well as their average ages, length of record, mortality survival ratios and average sizes. Figure 1 shows the mortality survival curves covering the record of the amount and sizes of pipe grouped as shown.

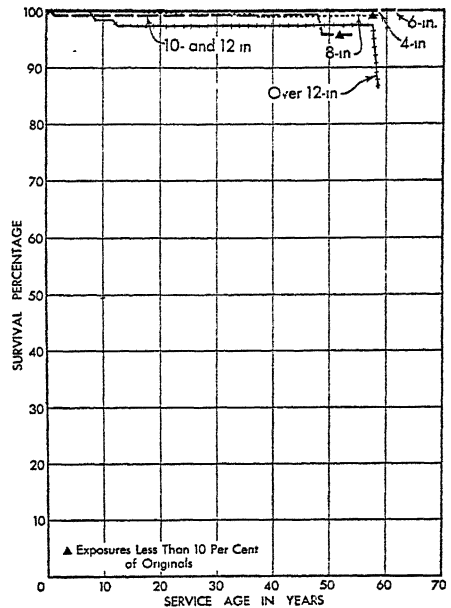


FIG. 2. Mortality Survival Curve—4-30-in. Gate Valves—Des Moines, Iowa

BASE: Unit		SURVIVAL: 1881-1942	
SIZE	EXPOSURES	RETIREMENTS	
<i>in.</i>	<i>Units</i>	<i>Units</i>	
4	13	0	
6	501	0	
8	1,791	4	
10 and 12	167	2	
Over 12	116	4	

Tables 2, 3 and 4 are similar summaries of gate valves, meters and hydrants with Figs. 2, 3 and 4 representing the applicable mortality survival curves.

Causes of Retirement

The causes of retirement of mains are given in Table 5. Old pipe taken up has shown almost no tuberculation or corrosion. Of the total retirements of water mains approximately 33.3 per cent were because of inadequacy, 45.1

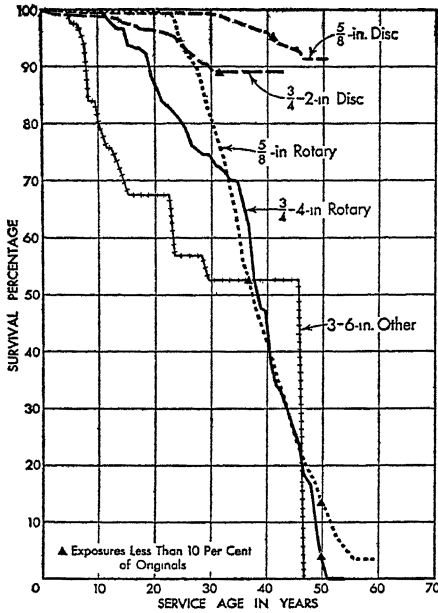


FIG. 3. Mortality Survival Curve— $\frac{5}{8}$ -6-in. Meters—Des Moines, Iowa

BASE: Unit		SURVIVAL: 1882-1942	
SIZE	KIND	EXPOSURES	RETIREMENTS
<i>in.</i>		<i>Units</i>	<i>Units</i>
$\frac{5}{8}$ -2	Disc	37,493	466
	Rotary	1,853	1,610
$\frac{3}{4}$ -4	Disc	1,187	64
$\frac{3}{4}$ -4	Rotary	129	129
3-6	Other	42	18

per cent because of other construction by public authorities and 21.6 per cent because of other factors, including 18.4 per cent which could not definitely be determined from the records. Approximately 51.5 per cent of the total footage of mains retired which could definitely be identified were salvaged and re-used.

The retirement of gate valves was almost entirely dependent upon the retirement of mains in which they were located. Except for the abandonment of one 8-in. valve, valves retired were

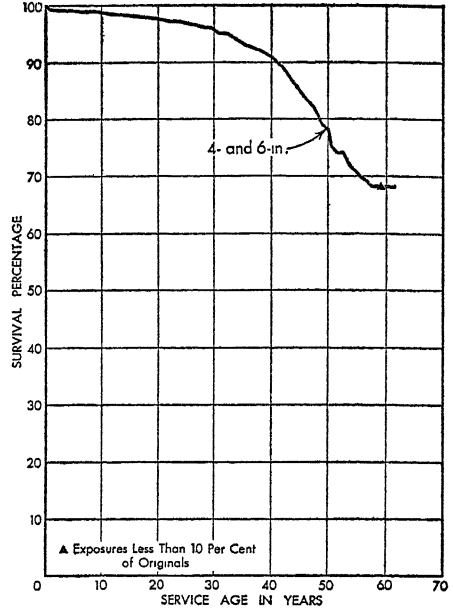


FIG. 4. Mortality Survival Curve—4- and 6-in. Hydrants—Des Moines, Iowa

BASE: Unit		SURVIVAL: 1881-1942	
SIZE		EXPOSURES	RETIREMENTS
<i>m.</i>	<i>Units</i>	<i>Units</i>	<i>Units</i>
4 and 6	3,733		279

removed, repaired and again used at other locations.

It was not possible to ascertain definite reasons for the retirement of individual meters. As a matter of policy rotary meters have not been installed in any number since 1900 and those previously installed have been retired more generously than other types to secure uniformity in the type and kind of meters in service.

No definite record has been kept of the causes dictating the retirement of hydrants by sizes. While the record reflects the retirement of hydrants whenever taken out, it is stated that in the greater percentage of retirements the hydrants taken out were repaired and used again in other locations.

Acknowledgments

The collection and compilation of data in Des Moines were under the general supervision of Dale L. Maffitt, General Manager and a member of the Committee on Survival and Retirement

Experience With Water Works Facilities. R. B. Wood, Office Engineer; H. King Dawson, Assistant Office Engineer; and W. E. Bjork, Superintendent of the Meter Department, were in charge of abstracting the records.

SUMMARY OF CLASS B FACILITIES—DES MOINES, IOWA

Infiltration Galleries

No. 1—Rectangular gallery, 4 ft. \times 5 ft. in section, 1,077 ft. long, of wood construction, surrounded by crushed stone. Constructed in 1884–1886 and retired in 1922 when a new supply in a different location was constructed.

No. 2—Similar gallery of same type of construction, 4 ft. \times 3½ ft. in section, 1,594 ft. long. Constructed in 1887 and retired in 1922 when new supply was constructed.

No. 3—Similar gallery of same type of construction, 5 ft. \times 3 ft. in section, 1,250 ft. long. Constructed in 1894; 432 ft. abandoned in 1922 when new supply was constructed but 818 ft. was connected to the new galleries and is still in service.

No. 4—Similar gallery of same type of construction, 5 ft. \times 3½ ft. in section, 1,000 ft. long. Constructed in 1904 and still in service, together with a cross-connection of 20-in. cast-iron pipe, 430 ft. long, between gallery Nos. 3 and 4.

No. 5—Circular gallery of reinforced concrete, 4-ft. id., set on cradles consisting of 3,194 ft. of rings with 108 ft. of cast-iron pipe, and surrounded with crushed tile. Constructed in 1910–1911 and still in service.

No. 6—Similar gallery to No. 5, 4-ft. id., 3,398 ft. of rings with 72 ft. of cast-iron pipe. Constructed in 1914–1916 and still in service.

No. 7—Steel and concrete gallery, 4-ft. id., 5,000 ft. of rings, set on cradles with loose gravel jacket. Constructed in 1923–1924 and still in service.

No. 8—Similar gallery, 5-ft. id., 4,600 ft. long. Constructed in 1932 and still in service.

Tunnel No. 1—The pumping station end of the filter galleries consists of 6-ft. arched monolithic concrete tunnel, 2,510 ft. long, constructed in 1927–1928 and still in service.

Wells

Suction Well—Brick well, 46 ft. 8 in. in diameter, 31 ft. deep, cased for 26 ft. in depth forming suction well for gallery supply. Constructed in 1882 and retired in 1922 when new supply was developed.

River Well—Brick well, 20 ft. in diameter, 22 ft. deep, used for pump suction well. Constructed in 1887 and retired in 1922 when new supply was developed.

Siphon Well—Brick well, 16 ft. 8 in. in diameter, 44 ft. 2 in. deep, 20-in. reinforced brick masonry walls. Constructed in 1904 and retired in 1922 when new supply was developed.

Suction Well—Reinforced concrete pump suction well, 100 ft. \times 12 ft. in plan, 25 ft. deep. Constructed in 1922 and still in service.

Pumping Equipment

Old Station

Gaskill 6-mgd., horizontal, compound steam-engine pumping unit; 80-lb. domestic and 140-lb. fire pressure; installed 1883; retired 1921 with construction of new plant.

Worthington 6-mgd., horizontal, compound steam-engine pumping unit; 80-lb. domestic and 135-lb. fire pressure; installed 1884; retired 1921 with construction of new plant.

Holly-Gaskill 8-mgd., horizontal, compound condensing steam-engine pumping unit; 110-lb. domestic and 140-lb. fire pressure; installed 1902; retired 1921 with construction of new plant.

Snow 10-mgd., horizontal, cross compound steam-engine pumping unit; 108-lb. domestic and 150-lb. fire pressure; installed 1910; retired 1921 with construction of new plant.

New Station

No. 1—DeLaval geared, steam-turbine-driven pumping unit, 15-mgd. capacity, 269-ft. head, 1,100 hp.; installed 1920 and still in service.

No. 2—Similar DeLaval unit; installed 1921 and still in service.

No. 3—DeLaval geared, steam-turbine-driven pumping unit, 25-mgd. capacity, 269-ft. head, 1,424 hp.; installed 1922 and still in service.

No. 4—DeLaval geared, steam-turbine-driven pumping unit, 30-mgd. capacity, 280-ft. head, 1,750 hp.; installed 1928 and still in service.

TABLE 5
CAUSES OF RETIREMENT OF MAINS—DES MOINES, IOWA

Size, <i>ins.</i>	Kind	Length, <i>ft.</i>	Life, <i>yr.</i>	Cause of Retirement	Salvage, <i>ft.</i>
4	Cast-iron unlined	300	57.5	Replaced by 8-in. main	0
		72	44.5	Replaced by 8-in. main	0
		372			0
6	Cast-iron unlined	257	11.5	Replaced by 8-in. main	0
		180	39.5	Replaced by 8-in. main	180
		450	28.5		0
		371	31.5	State Capitol construction	0
		20	36.5		20
		678	36.5		Change in street grade
		180	7.5		0
		168	14.5		0
		181	17.5		0
		169	24.5	Unknown	0
		181	27.5		0
		169	34.5		0
		181	37.5		0
		169	44.5		0
		3,354			500
8	Cast-iron unlined	55	15.5	Underpass construction	55
		1,077	27.5	Underpass construction	1,077
		400	18.5	Change in street grade	400
		200	17.5		200
		798	30.5	Replaced by 12-in. main	798
		1,190	50.5		0
		279	36.5	Replaced by 12- and 16-in. mains	0
		818	13.5	Replaced by 12-in. main	818
		78	16.5	Abandoned service	78
		4,895			3,426
12	Cast-iron unlined	202	28.5	Viaduct construction	202
		168	19.5	Replaced by 24-in. main	0
		370			
16	Cast-iron unlined	365	57.5	Replaced by 20-in. main	365
		365			365
20	Cast-iron unlined	700	30.5	River crossing	0
		220	21.5	Abandonment of old pump station	220
		296	46.5	Unknown	0
		1,216			220
24	Cast-iron unlined	9	18.5	Replaced by 20-in. main	9
		9			9
30	Cast-iron unlined	276	4.5	Dam failure	276
		1,950	16.5	Relocation of river crossing	1,600
		2,226			1,876
TOTAL		12,807			6,598

SUMMARY OF CLASS B FACILITIES (contd.)

Field Stations

No. 1—Horizontal, motor-driven centrifugal pumping unit, 5-mgd. capacity, 18-ft. head, 25-hp. motor; installed 1918 and still in service.

No. 2—Similar to No. 1.

No. 3—Horizontal, motor-driven centrifugal pumping unit, 10-mgd. capacity, 18-ft. head, 40-hp. motor; installed 1926 and still in service.

Sand Plant—Horizontal, motor-driven centrifugal pumping unit, 1.5-mgd. capacity,

15-ft. head, 7½-hp. motor; installed 1932 and still in service.

Tanks and Standpipes

17th Street Standpipe—30 ft. in diameter by 100 ft. high; 530,000-gal. capacity; boiler steel; erected 1890; retired 1940 because of inadequate capacity and not in condition for enlarging.

Allen Hazen Elevated Tank—110-ft. diameter by 28.6-ft. depth on 73.7-ft. tower to flow line; capacity 2 mil. gal.; erected 1930–1931 and still in service.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
DES MOINES, IOWA

MAINS

4-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	400	28	372	Unknown	17,811	16,519	1,292
1923	15	15	0				
1926	34	34	0	TOTAL	18,312	16,648	1,664
1934	44	44	0				
1937	8	8	0				
1942	0	0	0				
				<i>Retirements by Years</i>			
				<i>Year</i>			
				<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
				1881	72	1925	300
SUBTOTAL	501	129	372				

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	676	676	0	1906	1,295	1,295	0
1883	787	787	0	1907	48	48	0
1884	19,276	18,885	391	1909	1,072	1,072	0
1885	2,703	2,703	0	1910	2,427	2,427	0
1886	14,917	14,059	858	1911	4,426	4,426	0
1887	28,464	28,014	450	1912	2,105	2,105	0
1888	17,021	17,021	0	1913	478	478	0
1889	4,202	4,202	0	1914	3,500	3,243	257
1890	4,856	4,856	0	1915	1,703	1,703	0
1891	745	745	0	1916	166	166	0
1892	3,211	3,211	0	1918	815	815	0
1895	956	956	0	1920	12	12	0
1896	413	413	0	1921	285	285	0
1898	2,313	2,313	0	1922	3	3	0
1899	4,655	4,655	0	1923	1,583	1,583	0
1900	1,669	1,669	0	1924	6,874	6,874	0
1901	2,089	2,089	0	1925	5,725	5,725	0
1902	172	172	0	1926	91	91	0
1903	4,509	4,509	0	1927	2,415	2,415	0
1904	6,544	6,544	0	1928	782	782	0
1905	542	542	0	1929	571	571	0

SURVIVAL AND RETIREMENT

6-IN. CAST-IRON UNLINED MAINS (contd.)

Year				Feet			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1930	307	307	0	1940	14,671	14,671	0
1931	5,514	5,514	0	1941	10,995	10,995	0
1932	6,278	6,278	0	1942	2,852	2,852	0
1934	8,807	8,807	0				
1935	242	242	0	SUBTOTAL	261,499	259,543	1,956
1937	14,378	14,378	0	Unknown	66,471	65,073	1,398
1938	19,668	19,668	0				
1939	20,691	20,691	0	TOTAL	327,970	324,616	3,354

Retirements by Years

Year					Year		
Installed	Feet	Year	Feet	Year	Installed	Feet	Year
1884	371	1915	20	1920	1887	450	1915
1886	678	1922	180	1925	1914	257	1925

8-IN. CAST-IRON UNLINED MAINS

Year				Feet			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1884	6,125	6,125	0	1916	47,293	47,293	0
1886	10,876	10,876	0	1917	23,870	23,870	0
1887	7,526	7,526	0	1918	16,303	16,303	0
1888	20,200	19,010	1,190	1919	68	68	0
1889	12,613	12,613	0	1920	16,733	16,733	0
1890	36,412	36,133	279	1921	36,287	36,087	200
1891	26,517	26,517	0	1922	25,844	25,844	0
1892	15,249	15,249	0	1923	53,373	53,373	0
1893	781	781	0	1924	90,942	90,942	0
1894	6,907	6,907	0	1925	89,246	89,168	78
1895	2,698	2,698	0	1926	126,670	126,615	55
1896	4,770	4,770	0	1927	13,881	13,881	0
1897	6,726	6,726	0	1928	4,665	4,665	0
1898	8,649	8,649	0	1929	28,540	28,540	0
1899	1,403	1,403	0	1930	3,811	3,811	0
1900	10,752	10,752	0	1931	78,961	78,961	0
1901	8,867	8,867	0	1932	7,212	7,212	0
1902	8,650	8,650	0	1934	34,103	34,103	0
1903	12,444	12,444	0	1935	57	57	0
1904	43,619	43,219	400	1936	12,178	12,178	0
1905	22,819	22,819	0	1937	33,646	33,646	0
1906	10,276	10,276	0	1938	53,414	53,414	0
1907	23,173	21,557	1,616	1939	56,322	56,322	0
1908	8,028	8,028	0	1940	29,280	29,280	0
1909	20,496	20,496	0	1941	23,729	23,729	0
1910	17,336	17,336	0	1942	9,046	9,046	0
1911	37,196	37,196	0				
1912	39,394	39,394	0	SUBTOTAL	1,488,250	1,483,355	4,895
1913	36,476	36,476	0	Unknown	73,017	64,110	8,907
1914	46,154	45,077	1,077				
1915	59,644	59,644	0	TOTAL	1,561,267	1,547,465	13,802

8-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Year</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>					<i>Installed</i>			
1888	1,190	1938			1914	1,077	1941	
1890	279	1926			1921	200	1938	
1904	400	1922			1925	78	1941	
1907	818	1920	798	1937	1926	55	1941	

10-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1896	1,355	1,355	0	Unknown	4,950	4,400	550
1942	0	0	0				
SUBTOTAL	1,355	1,355	0	TOTAL	6,305	5,755	550

12-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1888	1,226	1,226	0	1923	1,946	1,946	0
1889	1,371	1,371	0	1924	7,471	7,471	0
1890	5,149	5,149	0	1925	7,222	7,222	0
1891	3,459	3,459	0	1926	20,042	20,042	0
1892	1,618	1,618	0	1927	23	23	0
1893	1,055	1,055	0	1929	3,160	3,160	0
1894	1,172	1,172	0	1931	25,671	25,671	0
1895	1,665	1,665	0	1934	794	794	0
1896	4,850	4,648	202	1935	13	13	0
1898	1,088	1,088	0	1937	8,521	8,521	0
1899	3,279	3,279	0	1938	6,241	6,241	0
1902	17,115	17,115	0	1939	4,438	4,438	0
1903	8,041	7,873	168	1940	1,545	1,545	0
1904	6,088	6,088	0	1942	0	0	0
1906	13,746	13,746	0				
1907	149	149	0	SUBTOTAL	185,711	185,341	370
1908	677	677	0	Unknown	3,264	3,264	0
1909	1,429	1,429	0				
1910	3,771	3,771	0	TOTAL	188,975	188,605	370
1911	2,061	2,061	0				
1912	1,566	1,566	0	<i>Retirements by Years</i>			
1913	3,489	3,489	0	<i>Year</i>	<i>Feet</i>	<i>Year</i>	
1914	2,197	2,197	0	<i>Installed</i>			
1917	2,424	2,424	0	1896	202	1924	
1920	4,798	4,798	0	1903	168	1922	
1921	3,419	3,419	0				
1922	1,722	1,722	0				

SURVIVAL AND RETIREMENT

12-IN. STEEL MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1940	742	742	0
1942	0	0	0
TOTAL	742	742	0

14-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1941	36,477	36,477	0
1942	0	0	0
TOTAL	36,477	36,477	0

16-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1883	800	435	365
1884	3,558	3,558	0
1888	807	807	0
1889	2,250	2,250	0
1901	2,561	2,561	0
1925	1,787	1,787	0
1926	14,825	14,825	0
1927	3,327	3,327	0
1934	3,843	3,843	0
1935	444	444	0
1936	58	58	0
1937	143	143	0
1942	0	0	0
SUBTOTAL	34,403	34,038	365
Unknown	4,028	4,028	0
TOTAL	38,431	38,066	365

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>		
1883	365	1940

20-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1883	64	64	0
1887	1,152	156	996
1889	2,011	2,011	0
1893	4,659	4,659	0
1902	776	556	220
1904	351	351	0
1917	416	416	0
1920	24	24	0
1922	9	9	0
1929	23,100	23,100	0
1937	4,085	4,085	0
1939	8,703	8,703	0
1940	365	365	0
1942	0	0	0
TOTAL	45,715	44,999	1,216

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>				
1887	700	1917	296	1923
1902	220	1923		

24-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1922	1,659	1,650	9
1924	4,750	4,750	0
1942	0	0	0
TOTAL	6,409	6,400	9

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>		
1922	9	1940

30-IN. CAST-IRON UNLINED MAINS

<i>Year</i> <i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1920	2,710	760	1,950
1923	2,490	2,214	276
1927	276	276	0
1929	366	366	0
1934	7,631	7,631	0
1936	2,733	2,733	0
1937	1,798	1,798	0
1942	0	0	0
TOTAL	18,004	15,778	2,226

30-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Retirements by Years</i>			
<i>Year</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1920	1,950	1936	
1923	276	1927	
<hr/>			
30-IN. WRAPPED STEEL MAINS			
<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1936	1,826	1,826	0
1942	0	0	0
	<hr/>	<hr/>	<hr/>
TOTAL	1,826	1,826	0

VALVES

4-IN. VALVES

<i>Year</i> <i>Installed</i>	<i>Number</i>			<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1884	2	2	0	1937	3	3	0
1887	1	1	0	1942	0	0	0
1903	1	1	0		—	—	—
1917	1	1	0	SUBTOTAL	13	13	0
1923	1	1	0	Unknown	46	46	0
1927	2	2	0		—	—	—
1929	2	2	0	TOTAL	59	59	0

6-IN. VALVES

<i>Year</i> <i>Installed</i>	<i>Number</i>			<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	1	1	0	1905	3	3	0
1883	4	4	0	1906	4	4	0
1884	26	26	0	1909	2	2	0
1885	10	10	0	1910	2	2	0
1886	29	29	0	1911	10	10	0
1887	39	39	0	1912	5	5	0
1888	31	31	0	1913	3	3	0
1889	8	8	0	1914	11	11	0
1890	7	7	0	1915	5	5	0
1891	5	5	0	1916	1	1	0
1892	10	10	0	1919	1	1	0
1893	1	1	0	1920	3	3	0
1894	1	1	0	1921	2	2	0
1895	3	3	0	1923	4	4	0
1896	1	1	0	1924	7	7	0
1898	5	5	0	1925	4	4	0
1899	7	7	0	1926	2	2	0
1900	3	3	0	1927	2	2	0
1902	5	5	0	1929	4	4	0
1903	4	4	0	1930	1	1	0
1904	8	8	0				

SURVIVAL AND RETIREMENT

6-IN. VALVES (contd.)

<i>Year</i> <i>Installed</i>	<i>Number</i>			<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	8	8	0	1940	36	36	0
1932	8	8	0	1941	18	18	0
1934	14	14	0	1942	9	9	0
1935	1	1	0				
1936	1	1	0	SUBTOTAL	501	501	0
1937	26	26	0	Unknown	123	123	0
1938	42	42	0				
1939	54	54	0	TOTAL	624	624	0

8-IN. VALVES

<i>Year</i> <i>Installed</i>	<i>Number</i>			<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1884	4	4	0	1921	42	42	0
1886	17	17	0	1922	27	26	1
1887	6	6	0	1923	76	76	0
1888	21	21	0	1924	77	77	0
1889	11	11	0	1925	81	80	1
1890	39	39	0	1926	126	126	0
1891	42	42	0	1927	21	21	0
1892	15	15	0	1928	8	8	0
1893	3	3	0	1929	59	59	0
1894	12	11	1	1930	7	7	0
1895	7	7	0	1931	86	86	0
1896	7	7	0	1932	8	8	0
1897	8	8	0	1934	32	32	0
1898	9	9	0	1936	6	6	0
1899	6	6	0	1937	45	45	0
1900	11	11	0	1938	96	96	0
1901	9	9	0	1939	80	80	0
1902	7	7	0	1940	37	37	0
1903	15	15	0	1941	27	27	0
1904	52	52	0	1942	13	13	0
1905	27	27	0				
1906	13	13	0	SUBTOTAL	1,791	1,787	4
1907	18	18	0	Unknown	100	97	3
1908	13	13	0				
1909	24	24	0	TOTAL	1,891	1,884	7
1910	26	26	0				
1911	47	47	0				
1912	51	51	0				
1913	42	42	0				
1914	57	57	0				
1915	78	78	0				
1916	77	76	1				
1917	23	23	0				
1918	13	13	0				
1919	3	3	0				
1920	24	24	0				

<i>Retirements by Years</i>		
<i>Year</i> <i>Installed</i>	<i>Number</i>	<i>Year</i>
1894	1	1929
1916	1	1937
1922	1	1939
1925	1	1940
Unknown	3	

10-IN. VALVES

<i>Year</i>	<i>Number</i>			<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1896	3	3	0	Unknown	5	5	0
1942	0	0	0		—	—	—
	—	—	—	TOTAL	8	8	0
SUBTOTAL	3	3	0				

12-IN. VALVES

<i>Year</i>	<i>Number</i>			<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1888	1	1	0	1922	3	3	0
1889	1	1	0	1923	3	3	0
1890	13	12	1	1924	8	8	0
1891	5	5	0	1925	6	6	0
1892	4	4	0	1926	14	14	0
1893	3	3	0	1929	5	5	0
1895	1	1	0	1931	18	18	0
1896	5	5	0	1934	3	3	0
1898	1	1	0	1937	8	8	0
1899	1	1	0	1938	5	5	0
1902	6	6	0	1939	4	4	0
1903	7	7	0	1940	7	6	1
1904	3	3	0	1941	1	1	0
1906	4	4	0	1942	0	0	0
1908	1	1	0		—	—	—
1909	1	1	0	SUBTOTAL	164	162	2
1910	3	3	0	Unknown	6	6	0
1911	1	1	0		—	—	—
1912	1	1	0	TOTAL	170	168	2
1913	3	3	0				
1914	3	3	0	<i>Retirements by Years</i>			
1915	2	2	0	<i>Year</i>			
1917	1	1	0	<i>Installed</i>	<i>Number</i>	<i>Year</i>	
1918	2	2	0	1890	1	1937	
1919	1	1	0	1940	1	1940	
1920	5	5	0				

SURVIVAL AND RETIREMENT

14-IN. VALVES

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1941	14	14	0
1942	0	0	0
	—	—	—
TOTAL	14	14	0

16-IN. VALVES

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1883	3	1	2
1884	7	7	0
1888	1	1	0
1889	3	3	0
1904	1	1	0
1925	1	1	0
1926	7	6	1
1927	2	2	0
1929	1	1	0
1934	3	3	0
1937	2	2	0
1940	3	3	0
1942	0	0	0
	—	—	—
SUBTOTAL	34	31	3
Unknown	3	3	0
	—	—	—
TOTAL	37	34	3

Retirements by Years

Year	Number	Year
<i>Installed</i>		
1883	2	1940
1926	1	1937

20-IN. VALVES

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1883	1	1	0
1889	1	1	0
1893	6	6	0
1902	2	2	0
1929	13	13	0

20-IN. VALVES (contd.)

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1937	4	4	0
1939	7	7	0
1940	1	1	0
1942	0	0	0
	—	—	—
SUBTOTAL	35	35	0
Unknown	1	1	0
	—	—	—
TOTAL	36	36	0

24-IN. VALVES

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1922	2	2	0
1924	5	5	0
1942	0	0	0
	—	—	—
TOTAL	7	7	0

30-IN. VALVES

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1921	2	2	0
1923	6	6	0
1929	5	4	1
1934	4	4	0
1936	7	7	0
1937	1	1	0
1940	1	1	0
1942	0	0	0
	—	—	—
SUBTOTAL	26	25	1
Unknown	1	1	0
	—	—	—
TOTAL	27	26	1

Retirements by Years

Year	Number	Year
<i>Installed</i>		
1929	1	1936

HYDRANTS

4- AND 6-IN. HYDRANTS

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1881	1	1	0	1915	112	106	6
1883	4	2	2	1916	107	104	3
1884	53	42	11	1917	38	36	2
1885	3	1	2	1918	29	27	2
1886	58	49	9	1920	43	41	2
1887	85	76	9	1921	69	65	4
1888	79	65	14	1922	44	42	2
1889	46	36	10	1923	98	95	3
1890	95	74	21	1924	187	179	8
1891	82	65	17	1925	171	168	3
1892	50	39	11	1926	242	234	8
1893	30	16	14	1927	29	28	1
1894	21	16	5	1928	9	9	0
1895	7	7	0	1929	36	36	0
1896	19	18	1	1930	6	5	1
1897	14	12	2	1931	163	163	0
1898	20	15	5	1932	19	16	3
1899	17	10	7	1933	21	18	3
1900	24	16	8	1934	89	83	6
1901	31	14	17	1935	27	27	0
1902	34	32	2	1936	32	32	0
1903	43	32	11	1937	148	145	3
1904	104	97	7	1938	129	129	0
1905	44	42	2	1939	149	148	1
1906	42	41	1	1940	95	94	1
1907	61	52	9	1941	81	80	1
1908	11	11	0	1942	29	29	0
1909	49	47	2				
1910	58	57	1	SUBTOTAL	3,733	3,454	279
1911	84	81	3	Unknown	328	211	117
1912	86	84	2				
1913	76	69	7	TOTAL	4,061	3,665	396
1914	100	96	4				

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1883	1	1934	1	1940				1885	1	1935	1	1940		
1884	1	1923	1	1924	1	1934		1886	1	1924	1	1934	1	1935
	1	1935	5	1937	1	1939			2	1937	1	1938	2	1940
	1	1940							1	1941				

SURVIVAL AND RETIREMENT

4- AND 6-IN. HYDRANTS (contd.)

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1887	1	1933	3	1936	1	1937	1905	1	1926	1	1938		
	3	1938	1	1941			1906	1	1936				
1888	2	1933	3	1937	5	1938	1907	1	1922	1	1931	1	1936
	1	1939	1	1940	2	1942		5	1937	1	1940		
1889	3	1933	1	1936	2	1937	1909	1	1934	1	1941		
	1	1938	3	1939			1910	1	1940				
1890	1	1915	1	1920	4	1933	1911	1	1934	1	1937	1	1938
	1	1934	6	1937	4	1938	1912	1	1937	1	1938		
	1	1939	1	1940	2	1941	1913	1	1915	3	1916	1	1933
1891	1	1934	3	1935	1	1936		1	1939	1	1940		
	2	1937	2	1938	5	1939	1914	2	1928	2	1941		
	3	1941					1915	1	1916	1	1933	1	1935
1892	1	1932	2	1935	2	1936		2	1938	1	1939		
	3	1937	2	1938	1	1939	1916	1	1936	1	1937	1	1939
1893	1	1931	2	1933	2	1934	1917	1	1922	1	1937		
	5	1935	1	1936	2	1937	1918	1	1940	1	1942		
	1	1939					1920	2	1936				
1894	1	1932	1	1934	1	1935	1921	1	1931	2	1936	1	1937
	1	1939	1	1940			1922	1	1931	1	1940		
1896	1	1940					1923	1	1937	2	1941		
1897	2	1941					1924	1	1926	1	1934	1	1936
1898	1	1932	1	1939	2	1940		2	1937	1	1939	1	1941
	1	1941						1	1942				
1899	2	1932	1	1933	1	1939	1925	1	1928	1	1935	1	1937
	1	1940	2	1941			1926	3	1927	1	1936	2	1937
1900	1	1932	1	1933	1	1934		1	1939	1	1942		
	1	1935	2	1941	2	1942	1927	1	1937				
1901	1	1921	1	1929	1	1931	1930	1	1939				
	1	1933	1	1934	2	1935	1932	3	1937				
	5	1937	1	1938	2	1939	1933	1	1937	1	1939	1	1942
	2	1940					1934	1	1934	1	1935	1	1938
1902	1	1937	1	1940				2	1939	1	1942		
1903	1	1922	1	1932	1	1933	1937	2	1937	1	1940		
	1	1936	3	1937	1	1938	1939	1	1940				
	1	1939	1	1941	1	1942	1940	1	1940				
1904	1	1926	1	1930	2	1934	1941	1	1941				
	2	1937	1	1939									

METERS

½-IN. DISC METERS

<i>Year Installed</i>	<i>Number</i>			<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1890	7	0	7	1900	506	503	3
1891	9	0	9	1901	605	603	2
1892	20	10	10	1902	832	825	7
1893	1	0	1	1903	803	781	22
1895	27	25	2	1904	868	848	20
1896	115	62	53	1905	974	972	2
1897	181	149	32	1906	1,503	1,497	6
1898	344	238	106	1907	1,246	1,203	43
1899	488	479	9	1908	503	499	4

$\frac{3}{8}$ -IN. DISC METERS (contd.)

<i>Year</i>				<i>Year</i>			
<i>Number</i>		<i>Number</i>		<i>Number</i>		<i>Number</i>	
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1909	1,099	1,096	3	1928	1,002	1,000	2
1910	655	653	2	1930	1,000	999	1
1911	611	606	5	1931	1,000	999	1
1912	793	786	7	1932	100	100	0
1913	1,033	1,019	14	1933	500	500	0
1914	1,229	1,222	7	1934	555	555	0
1915	1,009	1,000	9	1935	1,001	1,001	0
1916	800	795	5	1936	1,000	1,000	0
1917	345	341	4	1937	1,000	1,000	0
1918	1,712	1,687	25	1938	1,000	1,000	0
1919	1,001	1,001	0	1939	1,000	999	1
1920	929	919	10	1940	234	234	0
1921	1,279	1,263	16	1942	656	656	0
1922	1,001	999	2				
1923	1,415	1,413	2	SUBTOTAL	37,493	37,027	466
1924	1,501	1,498	3	Unknown	12	11	1
1925	1,005	1,002	3				
1926	996	990	6	TOTAL	37,505	37,038	467

Retirements by Years

<i>Year</i>	<i>Num-</i>	<i>Num-</i>	<i>Num-</i>	<i>Year</i>	<i>Num-</i>	<i>Num-</i>	<i>Num-</i>	<i>Year</i>	<i>Num-</i>	<i>Num-</i>	<i>Num-</i>	<i>Year</i>	<i>Num-</i>	<i>Num-</i>	<i>Num-</i>
<i>Installed</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Installed</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>
1890	1	1920	1	1922	1	1927		1902	6	1932	1	1934			
	2	1933	1	1934	1	1935		1903	1	1930	9	1932	2	1934	
1891	1	1923	3	1924	1	1925			4	1935	3	1936	2	1937	
	2	1931	1	1933	1	1935			1	1941					
1892	1	1931	3	1932	2	1934		1904	6	1932	1	1933	2	1934	
	1	1935	1	1936	1	1937			5	1936	1	1937	2	1938	
	1	1938							2	1939	1	1942			
1893	1	1930						1905	1	1932	1	1939			
1895	2	1932						1906	5	1932	1	1935			
1896	3	1929	4	1930	4	1931		1907	4	1932	18	1934	5	1935	
	6	1932	8	1933	3	1934			3	1936	4	1937	1	1938	
	6	1935	11	1936	7	1937			1	1939	1	1940	3	1941	
	1	1939							3	1942					
1897	1	1926	2	1929	1	1930		1908	1	1933	1	1935	2	1940	
	2	1931	5	1932	5	1933		1909	2	1932	1	1936			
	4	1934	2	1935	3	1936		1910	1	1929	1	1932			
	2	1937	4	1938	1	1939		1911	1	1931	4	1942			
1898	3	1929	4	1930	7	1931		1912	1	1932	1	1933	2	1934	
	25	1932	19	1933	13	1934			1	1936	1	1940	1	1941	
	8	1935	7	1936	3	1937		1913	1	1932	5	1933	4	1934	
	6	1938	7	1939	3	1940			2	1940	1	1941	1	1942	
	1	1941						1914	1	1932	2	1933	2	1941	
1899	6	1932	1	1936	1	1939			2	1942					
	1	1940						1915	5	1933	2	1934	1	1940	
1900	3	1932							1	1942					
1901	1	1932	1	1933				1916	3	1933	2	1934			

SURVIVAL AND RETIREMENT

 $\frac{5}{8}$ -IN. DISC METERS (contd.)

Retirements by Years (contd.)

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year	Num- ber	Year	Num- ber	Year	Num- ber	Year
1917	1	1933	3	1934				1923	1	1924	1	1925		
1918	15	1933	6	1934	1	1936		1924	2	1932	1	1934		
	1	1940	1	1941	1	1942		1925	1	1928	1	1937	1	1939
1920	5	1933	5	1934				1926	6	1927				
1921	1	1928	5	1932	1	1933		1928	1	1929	1	1940		
	4	1934	1	1936	3	1938		1930	1	1931				
	1	1939						1931	1	1931				
1922	1	1936	1	1941				1939	1	1941				

 $\frac{3}{4}$ -IN. DISC METERS

Year Installed	Number		
	Installed	In Service	Retired
1904	1	1	0
1908	1	1	0
1910	2	2	0
1911	1	1	0
1912	22	22	0
1914	15	15	0
1915	10	10	0
1917	5	5	0
1918	5	5	0
1919	2	2	0
1920	9	9	0
1921	40	37	3
1923	15	15	0
1924	23	23	0
1925	12	12	0
1926	20	20	0
1927	20	20	0
1928	11	11	0
1929	17	17	0
1930	23	22	1
1931	48	48	0
1942	0	0	0
SUBTOTAL	302	298	4
Unknown	1	0	1
TOTAL	303	298	5

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1921	2	1937	1	1938		
1930	1	1938				

1-IN. DISC METERS

Year Installed	Number		
	Installed	In Service	Retired
1900	2	2	0
1902	6	6	0
1903	3	3	0
1904	2	2	0
1905	10	10	0
1906	9	9	0
1907	5	5	0
1908	12	12	0
1909	16	16	0
1910	12	12	0
1912	45	42	3
1913	17	17	0
1914	35	35	0
1915	15	15	0
1917	34	34	0
1918	23	23	0
1919	11	11	0
1921	44	40	4
1923	25	21	4
1924	28	28	0
1925	12	12	0
1926	23	23	0
1927	10	10	0
1928	11	11	0
1929	12	12	0
1942	0	0	0
TOTAL	422	411	11

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1912	1	1936	2	1942		
1921	1	1922	1	1935	1	1936
	1	1937				
1923	1	1935	1	1936	2	1937

1½-IN. DISC METERS

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1900	2	0	2	1924	11	11	0
1904	5	0	5	1925	10	10	0
1905	2	0	2	1926	16	16	0
1906	1	1	0	1927	12	12	0
1907	2	1	1	1929	24	24	0
1908	1	1	0	1942	0	0	0
1909	2	2	0				
1910	1	1	0	TOTAL	152	137	15
1911	3	3	0				
1912	3	3	0	Retirements by Years			
1913	11	11	0	Year	Num-	Num-	Num-
1914	6	6	0	Installed	ber	Year	ber
1915	6	6	0	1900	1	1919	1
1917	5	5	0	1904	2	1921	2
1918	10	10	0	1905	2	1929	1
1919	4	3	1	1907	1	1919	
1920	5	5	0	1919	1	1937	
1921	10	6	4	1921	2	1924	1
						1941	1
						1942	1942

2-IN. DISC METERS

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1903	4	0	4	1929	24	21	3
1904	3	0	3	1930	16	15	1
1905	6	0	6	1931	11	11	0
1906	2	1	1	1942	0	0	0
1907	1	1	0				
1909	2	2	0	TOTAL	311	277	34
1910	7	4	3				
1911	2	2	0	Retirements by Years			
1912	17	17	0	Year	Num-	Num-	Num-
1913	3	3	0	Installed	ber	Year	ber
1914	11	9	2	1903	3	1929	1
1915	4	4	0	1904	1	1929	1
1916	1	1	0	1905	1	1921	3
1917	13	13	0			1929	1
1918	16	16	0			1933	
1919	8	8	0	1906	1	1929	
1920	5	4	1	1910	1	1926	1
1921	31	26	5	1914	1	1936	1
1922	11	11	0	1920	1	1933	
1923	20	20	0	1921	2	1933	2
1924	34	30	4	1924	2	1932	2
1925	28	28	0	1926	1	1936	
1926	22	21	1	1929	1	1929	1
1927	9	9	0	1930	1	1931	1
						1934	1934

SURVIVAL AND RETIREMENT

 $\frac{5}{8}$ -IN. ROTARY METERS

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1882	4	0	4	1887	4	0	4
1884	105	2	103	1898	25	24	1
1885	67	0	67	1899	2	0	2
1886	138	1	137	1900	1	0	1
1887	180	0	180	1901	3	1	2
1888	166	2	164	1902	1	0	1
1889	180	23	157	1939	23	22	1
1890	176	19	157	1942	0	0	0
1891	153	5	148				
1892	246	10	236	SUBTOTAL	1,853	243	1,610
1893	50	10	40				
1894	58	40	18	Unknown	43	0	43
1895	61	53	8				
1896	210	31	179	TOTAL	1,896	243	1,653

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1882	4	1920						1887	10	1910	2	1911	4	1912
1884	1	1894	6	1910	2	1911			2	1913	4	1914	3	1915
	3	1912	3	1913	2	1914			5	1916	8	1917	8	1919
	3	1915	4	1916	5	1917			15	1920	15	1921	18	1922
	13	1920	11	1921	3	1922			4	1923	20	1924	9	1925
	4	1923	8	1924	4	1925			8	1926	4	1927	1	1928
	3	1926	2	1927	2	1928			4	1929	4	1930	5	1931
	3	1929	2	1930	3	1931			7	1932	9	1933	2	1934
	1	1932	5	1933	3	1934			3	1935	2	1936	1	1937
	2	1935	1	1936	2	1937			2	1939	1	1941		
	1	1938	1	1939				1888	1	1910	2	1911	2	1912
1885	5	1910	1	1911	2	1913			4	1913	6	1916	7	1917
	2	1915	1	1916	3	1917			4	1919	8	1920	13	1921
	7	1919	7	1920	6	1921			13	1922	18	1923	8	1924
	4	1922	3	1923	3	1924			4	1925	11	1926	3	1927
	3	1925	1	1926	2	1928			4	1928	4	1929	4	1930
	4	1929	1	1931	2	1932			9	1931	9	1932	8	1933
	5	1933	1	1934	2	1935			8	1934	4	1935	1	1936
	1	1936	1	1938					2	1937	3	1938	1	1939
1886	5	1910	1	1911	2	1912			1	1940	2	1942		
	4	1913	3	1914	1	1915		1889	1	1910	1	1913	1	1917
	4	1916	6	1917	4	1919			1	1919	6	1920	12	1921
	14	1920	16	1921	11	1922			6	1922	6	1923	12	1924
	5	1923	7	1924	3	1925			4	1925	4	1926	5	1927
	7	1926	4	1927	4	1928			8	1928	3	1929	11	1930
	5	1929	3	1930	9	1931			1	1931	9	1932	10	1933
	5	1932	4	1933	5	1934			12	1934	7	1935	5	1936
	1	1935	1	1936	1	1937			5	1937	5	1938	3	1939
	2	1938							7	1940	1	1941	11	1942

$\frac{5}{8}$ -IN. ROTARY METERS (contd.)*Retirements by Years*

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1890	2	1910	1	1914	2	1915	1893	1	1921	2	1922	2	1923
	2	1917	4	1919	7	1920		4	1924	1	1925	3	1927
	4	1921	5	1922	1	1923		2	1929	2	1930	2	1932
	14	1924	8	1925	7	1926		9	1933	2	1934	1	1935
	2	1927	2	1928	9	1929		3	1936	2	1937	3	1938
	6	1930	10	1931	11	1932		1	1941				
	14	1933	11	1934	4	1935	1894	1	1920	2	1924	1	1927
	7	1936	2	1937	6	1938		1	1929	3	1930	1	1931
	5	1939	2	1940	1	1941		1	1932	2	1933	1	1934
	8	1942						2	1936	1	1938	1	1939
1891	1	1911	1	1917	13	1920		1	1942				
	9	1921	11	1922	9	1923	1895	1	1922	1	1925	1	1936
	14	1924	7	1925	8	1926		1	1938	2	1940	2	1942
	2	1928	10	1929	6	1930	1896	5	1917	46	1920	18	1921
	3	1931	7	1932	14	1933		11	1922	18	1923	16	1924
	3	1934	7	1935	7	1936		7	1925	7	1926	4	1927
	2	1937	5	1938	3	1939		2	1928	2	1929	7	1930
	5	1940	1	1942				6	1931	5	1932	6	1933
1892	2	1910	1	1915	7	1917		2	1934	5	1935	3	1936
	32	1920	27	1921	18	1922		2	1937	2	1938	1	1939
	15	1923	24	1924	11	1925		1	1940	3	1941		
	13	1926	9	1927	4	1928	1897	1	1924	1	1929	2	1941
	4	1929	9	1930	8	1931	1898	1	1937				
	5	1932	16	1933	8	1934	1899	1	1923	1	1932		
	6	1935	7	1936	1	1937	1900	1	1935				
	3	1938	3	1939	1	1940	1901	2	1942				
	2	1941					1902	1	1939				
							1939	1	1940				

 $\frac{3}{4}$ -IN. ROTARY METERS

<i>Year Installed</i>	<i>Number</i>			<i>Retirements by Years</i>							
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year</i>
1883	17	0	17	1883	3	1920	1	1921	1	1922	
1884	22	0	22		2	1924	1	1926	1	1928	
1885	15	0	15		2	1929	3	1932	2	1933	
1896	1	0	1		1	1936					
1942	0	0	0	1884	5	1920	1	1921	3	1922	
	—	—	—		1	1923	1	1924	1	1927	
SUBTOTAL	55	0	55		2	1928	2	1930	3	1932	
					2	1933	1	1934			
Unknown	13	0	13	1885	4	1920	2	1922	1	1923	
	—	—	—		1	1924	1	1926	1	1928	
TOTAL	68	0	68		1	1929	1	1931	1	1932	
					1	1933	1	1934			
				1896	1	1920					

SURVIVAL AND RETIREMENT

1-IN. ROTARY METERS

<i>Year</i> <i>Installed</i>	<i>Number</i>			<i>Retirements by Years</i>					
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Year</i> <i>Installed</i>	<i>Num- ber</i>	<i>Year</i> <i>Year</i>	<i>Num- ber</i>	<i>Year</i> <i>Year</i>	<i>Num- ber</i>
1882	4	0	4	1882	1	1920	1	1922	1
1884	14	0	14		1	1930			
1885	4	0	4	1884	4	1921	2	1923	2
1887	1	0	1		1	1926	1	1929	1
1942	0	0	0		2	1932	1	1933	
	—	—	—	1885	1	1924	1	1926	1
SUBTOTAL	23	0	23		1	1931			
Unknown	3	0	3	1887	1	1931			
	—	—	—						
TOTAL	26	0	26						

1½-IN. ROTARY METERS

<i>Year</i> <i>Installed</i>	<i>Number</i>			<i>Retirements by Years</i>				
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Year</i> <i>Installed</i>	<i>Num- ber</i>	<i>Year</i> <i>Year</i>	<i>Num- ber</i>	<i>Year</i> <i>Year</i>
1883	2	0	2	1883	1	1920	1	1931
1884	1	0	1	1884	1	1932		
1885	2	0	2	1885	1	1925	1	1926
1887	2	0	2	1887	1	1934	1	1935
1892	1	0	1	1892	1	1929		
1942	0	0	0					
	—	—	—					
SUBTOTAL	8	0	8					
Unknown	1	0	1					
	—	—	—					
TOTAL	9	0	9					

2-IN. ROTARY METERS

<i>Year</i> <i>Installed</i>	<i>Number</i>			<i>Retirements by Years</i>						
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Year</i> <i>Installed</i>	<i>Num- ber</i>	<i>Year</i> <i>Year</i>	<i>Num- ber</i>	<i>Year</i> <i>Year</i>	<i>Num- ber</i>	<i>Year</i> <i>Year</i>
1883	1	0	1	1883	1	1922				
1896	1	0	1	1896	1	1926				
1897	2	0	2	1897	1	1923	1	1932		
1898	4	0	4	1898	3	1924	1	1929		
1899	2	0	2	1899	1	1922	1	1932		
1900	1	0	1	1900	1	1922				
1902	8	0	8	1902	3	1921	1	1927	1	1929
1903	6	0	6		1	1930	1	1932	1	1934
1905	9	0	9	1903	1	1921	1	1922	2	1923
1908	1	0	1		1	1924	1	1926		
1920	4	0	4	1905	4	1920	1	1921	1	1924
1942	0	0	0		1	1925	1	1926	1	1930
	—	—	—	1908	1	1929				
SUBTOTAL	39	0	39	1920	2	1931	1	1932	1	1933
Unknown	1	0	1							
	—	—	—							
TOTAL	40	0	40							

3-IN. ROTARY METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	3	0	3
1942	0	0	0
	—	—	—
TOTAL	3	0	3

Retirements by Years

<i>Year</i>	<i>Num-</i>	<i>Num-</i>	<i>Num-</i>	<i>Year</i>
<i>Installed</i>	<i>ber</i>	<i>ber</i>	<i>ber</i>	<i>Year</i>
1885	1	1923	2	1930

4-IN. ROTARY METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	1	0	1
1942	0	0	0
	—	—	—
SUBTOTAL	1	0	1
Unknown	1	0	1
	—	—	—
TOTAL	2	0	2

Retirements by Years

<i>Year</i>	<i>Number</i>	<i>Year</i>
1889	1	1922

3-IN. TORRENT METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1906	1	0	1
1907	1	0	1
1908	2	2	0
1910	1	1	0
1942	0	0	0
	—	—	—
TOTAL	5	3	2

Retirements by Years

<i>Year</i>	<i>Number</i>	<i>Year</i>
<i>Installed</i>		
1906	1	1935
1907	1	1930

4-IN. TORRENT METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1904	1	1	0
1907	3	2	1
1918	2	0	2
1942	0	0	0
	—	—	—
TOTAL	6	3	3

Retirements by Years

<i>Year</i>	<i>Number</i>	<i>Year</i>
<i>Installed</i>		
1907	1	1930
1918	2	1926

6-IN. TORRENT METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1906	1	1	0
1907	1	0	1
1910	1	1	0
1918	1	0	1
1942	0	0	0
	—	—	—
TOTAL	4	2	2

Retirements by Years

<i>Year</i>	<i>Number</i>	<i>Year</i>
<i>Installed</i>		
1907	1	1930
1918	1	1926

3-IN. PROPORTION METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1916	1	0	1
1917	2	2	0
1920	2	2	0
1923	1	1	0
1942	0	0	0
	—	—	—
TOTAL	6	5	1

Retirements by Years

<i>Year</i>	<i>Number</i>	<i>Year</i>
<i>Installed</i>		
1916	1	1930

4-IN. PROPORTION METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1890	2	0	2
1920	1	0	1
1921	1	0	1
1922	1	0	1
1942	0	0	0
	—	—	—
TOTAL	5	0	5

Retirements by Years

Year	Number		Year
<i>Installed</i>	<i>Number</i>		<i>Year</i>
1890	2		1936
1920	1		1930
1921	1		1926
1922	1		1930

6-IN. PROPORTION METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1917	2	1	1
1920	2	0	2
1923	1	0	1
1942	0	0	0
	—	—	—
TOTAL	5	1	4

Retirements by Years

Year	Number		Year	Number		Year
<i>Installed</i>	<i>Number</i>		<i>Year</i>	<i>Number</i>		<i>Year</i>
1917	1		1930			
1920	1		1930	1		1931
1923	1		1930			

3-IN. COMPOUND METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1914	1	1	0
1920	1	1	0
1942	0	0	0
	—	—	—
TOTAL	2	2	0

4-IN. COMPOUND METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1909	1	1	0
1926	2	2	0
1942	0	0	0
	—	—	—
TOTAL	3	3	0

6-IN. COMPOUND METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1922	1	0	1
1937	2	2	0
1941	2	2	0
1942	1	1	0
	—	—	—
TOTAL	6	5	1

Retirements by Years

Year	Number		Year
<i>Installed</i>	<i>Number</i>		<i>Year</i>
1922	1		1937

Detroit, Michigan

As of December 31, 1942

THE Detroit Municipal Water Works, operated through the Dept. of Water Supply of the city of Detroit, is governed by the Board of Water Comrs. appointed by the Mayor. The Board consists of four members, each appointed for a term of four years, serving without compensation.

Detroit is situated near the head of the Detroit River, connecting Lake Saint Clair and Lake Erie. The first white settlement was established, on the present site of the city, by Cadillac, in 1701. For more than a century after Detroit was founded, the matter of a suitable water supply presented no problems to the early settlers. Each household had its small wharf which projected into the Detroit River, from which water was drawn for the daily needs.

After the great fire of 1805, which destroyed the settlement, however, public wells were provided at advantageous locations primarily for fire protection, but also for the convenience of the settlers whose residences were removed from ready access to the river. These wells proved unsatisfactory, as the quality of the water was poor and the supply often failed during the summer months when water was most needed. Thus, it was not long until the inhabitants were again obtaining their supply from the river.

Private Utility Supply System

The inconvenience of obtaining water from the river, the failure of the wells and the constant threat of fire brought public demand for construction of water works, and on February 26, 1820, proposals were invited "... for the exclusive privilege of erecting water works within the city of Detroit, for the purpose of furnishing the inhabitants thereof with water for a certain number of years . . . the proposals to specify the sum and number of years." It was not until March 30, 1827, that the first privately owned water works was placed in operation.

The works consisted of a pumphouse with a cupola, 40 ft. high, which housed a 40-gal. cask. Two pumps, each of 5-in. bore, driven by horse power, raised the water into the cask in the cupola. The water flowed from the cask through tamarack logs of 4½-in. bore diameter to a reservoir at the corner of Jefferson and Randolph Sts. The reservoir was 16 ft. square, 6 ft. in depth and was constructed of 2-in. white oak planks calked with oakum. Water was piped from this reservoir through bored tamarack logs for distribution. By the summer of 1830, the works had been enlarged by the construction of a second reservoir and the addition of a steam-driven pump. The second reservoir was constructed

south of Fort St. between Wayne and Shelby Sts. It was of brick construction, 18 ft. square and 9 ft. deep, with a net capacity of almost 22,000 gal. This reservoir was filled from the river through a 3-in. line, and the water was lifted by a rotary pump driven by a 10-hp. steam engine. The engine, by the way, was owned by the Detroit Iron Works, situated at the southwest corner of Jefferson and Cass Ave., and served as the source of power for the foundry as well as the water works. In 1831 a third reservoir was added to the works, adjoining and connected to the one completed in 1830. This reservoir was constructed of oak plank, 40 ft. square and 10 ft. deep, with a capacity of about 120,000 gal. Shortly thereafter a pumping station site was acquired on the north side of Woodbridge St., between Cass and Wayne, upon which a pumphouse was constructed and a rotary pump, driven by a 20-hp. steam engine, was installed. In a short time, however, the rotary pump was retired and replaced by a double-acting force pump.

During a period of nine years, private interests endeavored, with little success, to supply the city with water, and on June 4, 1836, the city purchased the entire works for the sum of \$20,500.

Development of the Existing System

It is interesting to note that, immediately after the city took over the works, an agent was sent on an inspection trip through the East to study the existing water works in the cities of Philadelphia, New York and Pittsburgh, and was authorized to purchase cast-iron pipe for installation in the distribution system.

The city shortly purchased a site and commenced construction of a new

water works on the river at the foot of Orleans St. On June 3, 1841, the new works was placed in operation.

Contemporary descriptions of the Orleans St. Station indicate the plan was a duplicate of the old Manhattan Works in New York. It consisted of an elevated storage tank, a pumping station, machine shop and storage building and an intake. The enclosed elevated storage tank was made of cast iron, 60 ft. in diameter and 20 ft. deep, with a capacity of 425,000 gal. The tank was carried on a circular brick tower, 64 ft. in diameter, rising to a height of 50 ft. above the river, making the total distance from the river surface to the top of the tank 70 ft. The reservoir was filled by means of a double-acting piston pump driven by a 25-hp. steam engine. The intake pipe was 12 in. in diameter and terminated at a distance of 450 ft. from the shoreline, 6 ft. below the surface of the river. The water flowed from the elevated tank, or reservoir, by gravity through a 10-in. cast-iron transmission main to the distribution system as well as to the old reservoirs, south of Fort, constructed in 1830 and 1831. Soon after the Orleans St. works went into operation in 1841, the pumping station on Woodbridge, between Cass and Wayne, which started operations in 1831, was retired. The original transmission main from this station was cast iron, 10 in. in diameter, laid in 1838. A portion of this line, on Jefferson Ave., is still in service.

When the water works was purchased by the city in 1836, the population was 6,900; by 1850 it had increased to more than 20,000. To keep up with the heavily increasing demands, a new reservoir was constructed and placed in operation in

November 1857. This reservoir was built at Orleans and Erskine Sts., some 8,000 ft. north of the river and the pumping station. The reservoir consisted of two basins with earth embankments 30 ft. high. The embankments had a top width of 15 ft. and a bottom width of 103 ft. The inside slopes were faced with heavy masonry and the outside slopes were sodded. The total safe storage capacity was about 9 mil.gal. The high water line in the reservoir was some 50 ft. above the ground at the intersection of Jefferson and Woodward Aves. and about 75 ft. above the level of the river. River water was pumped through a 24-in. diameter cast-iron main in Orleans St. from the station to the reservoir. The outlet from the reservoir was also through a 24-in. cast-iron main.

Improvements were continually made in the Orleans St. Station. In the summer of 1861, one of the two steam pumps was changed from non-condensing to condensing and furnished with a cylinder of larger diameter. In 1863, the original steam pump, placed into operation in 1841, was retired and replaced with a condensing direct-acting steam unit, similar to the revamped Engine Number 2.

In 1864, the original elevated storage tank, which was constructed at the site of the Orleans St. Station in 1841, was retired from service. This retirement was made possible because improvements made at the station provided means for pumping directly into the mains, for the first time. This arrangement was used during periods when the 9-mil.gal. reservoir was taken out of service for cleaning and repairs.

In 1864, there were about 73 miles of pipe in the entire system, about 30

miles of which were bored tamarack logs.

In 1872, a new steam-driven pump was placed in operation in the Orleans St. Station and the intake was extended. There is evidence that this new pump actually delivered in excess of 12 mgd.

By 1873, the population of Detroit had increased to about 100,000. Because of the increased demand for water and the hazards of pollution from the rapidly expanding industries along the river, it became evident that the facilities would have to be expanded greatly at a new location farther upstream. Accordingly, a new site of 56 acres was purchased between Jefferson Ave. and the Detroit River, about 3 miles upstream from the Orleans St. Station. This is the present site of the Water Works Park Station, which has since been increased in area to almost double the original size. Construction of the new works was started on this site in 1874, and the work was completed in about three years.

The works consisted of a 5-ft. diameter intake, a settling basin, pumping station, boiler and coal storage houses, standpipe and the superintendent's residence.

The original intake was laid in about 27 ft. of water, and terminated about 1,100 ft. from the shore in a submerged crib in the Detroit River. This intake was constructed of wrought-iron pipe. A second and similar intake was laid in 1884.

The settling basin was 365 ft. by an average length of 775 ft., with a depth varying from 13 ft., at the river end, to 17 ft., at the outlet. On the river side a natural bank of earth was left to separate the basin from the Detroit River. The other three sides had

timber walls, supported on short piling, with clay puddle between the walls and the undisturbed earth.

The first steam pumping unit was placed in operation in November 1877. It was a compound beam engine connected to a piston pump of 24-mgd. capacity. A second pumping unit, practically a duplicate of the original, was placed in operation in 1880.

A third pumping unit, of 30-mgd. capacity, was installed in 1886, and, with two 42-in. transmission mains leading from the works, this station was adequate to carry the entire load. Accordingly, the 9-mil.gal. reservoir, at Orleans and Erskine, which was put into service in 1857, was retired from service. It appears that the old Orleans St. Station was retired in 1881, and that the structures were razed and the equipment disposed of in 1884.

The standpipe, made of wrought iron, was 5 ft. in diameter at the base and 30 in. at the top, and was 132 ft. high. It was removed from service in 1895.

Water Works Park Station

The Water Works Park Station and the distribution system continued to expand throughout the years. In 1905 a new exposed crib and intake tunnel was placed in service. The crib was constructed in the American channel, at the head of Belle Isle; the intake tunnel was driven through clay, is circular in cross-section, 10 ft. in internal diameter and has four-ring common brick walls. This crib is connected to the new intake, to be described later, and the 10-ft. diameter tunnel is still in service. The crib still serves as standby, with the ports bulkheaded and can be placed in service again on short notice in an emergency. The

settling basin, put in service in 1877, was retired in 1922, when filtration was started.

The foregoing briefly covers the history of the major water works plant structures, equipment and appurtenances over the period from 1827 to 1922. Since 1922, the Water Works Park Station has been expanded and the new Springwells Station placed in operation. There has been no retirement of major elements in the plants since.

Both the Water Works Park and Springwells Stations obtain their raw water supply from a common intake system in the Detroit River. This system includes a lagoon, with earth dikes, 2,650 ft. long by 400 ft. wide having a mean depth of 26 ft. The primary purpose of this lagoon is to eliminate troubles from ice at the intake. This exposed intake is situated at the west end of Belle Isle, and is connected with the old intake by means of a 10-ft. internal diameter plain concrete tunnel. The main tunnel from the new intake is 15½ ft. in internal diameter, and was constructed through limestone, at an elevation of about 180 ft. below the mean level of the Detroit River. This tunnel terminates at the shore on the Water Works Park Station site in a branch, one leg of which furnishes raw water to that station, the other being a plain concrete tunnel about 10½ miles in length, 2 miles of which is 14 ft. and the balance 12 ft. in inside diameter, which conducts the raw river water to the west side Springwells Station. At Pennsylvania and Forest Aves., the end of the 14-ft. diameter tunnel, an outlet is provided for a raw water tunnel connection to supply a future station in the north-eastern section of the city, the site for which has been acquired.

The main components of the present Water Works Park Station proper are the low-lift pumping station, high-lift pumping station, boiler house, coagulation basin, filtration plant and two filtered water reservoirs.

The low-lift pumping station went into service in 1923. It raises the raw water to the filter plant. There are five electrically driven, synchronous motor, centrifugal pumps, four of which have a rated capacity of 100 mgd. each, against a 20-ft. head, and the other, 65-mgd. capacity against the same head.

The high-lift pumping equipment is housed in two separate structures, one is the original building, finished in 1877 and subsequently expanded, and the other was completed in 1912. Survival and retirement of the main high service pumping units in both stations to the end of 1942 is shown below:

Unit No.	Capacity mgd.	Placed in Operation year	Useful Life or Years in Service	
			Re- tired year	years
1*	24	1877	1925	48
2*	24	1880	1925	45
3*	30	1884	1928	44
4†	24	1894	—§	48
5†	25	1903	—	39
6†	25	1903	—	39
7†	25	1911	—	31
8†	30	1913	—	29
9†	30	1913	—	29
10†	30	1914	—	28
11†	40	1920	—	22
12†	37	1925	—	17
1R‡	70	1926	—	16
2R‡	50	1926	—	16

* Steam compound beam type.

† Steam triple expansion type.

‡ Electrical-centrifugal replacements for Units 1 and 2.

§ This and the following units are still in service.

There are eleven boiler units in the present boiler house, with a total steaming capacity of about 190,000 lb.

per hour. The oldest boiler unit was installed in 1919 and the most recent went into operation in 1941. The boilers are coal-fired with underfeed stokers.

The coagulation basin is 480 ft. by 525 feet in plan, divided into two equal parts; capacity is 30 mil.gal. Constructed of reinforced concrete with pile foundations, it was placed in service in 1923.

The filter plant, housed in a structural steel and brick superstructure, consists of 80 filters each having an area of $\frac{1}{10}$ acre. Each has a filtering capacity of about 4.5 mgd. The plant went into operation in 1923.

There are two underground filtered water reservoirs with a total capacity of 60 mil.gal. These reservoirs are of reinforced concrete construction on pile foundations. The first reservoir, of 40-mil.gal. capacity, was placed in service in 1923; the second, of 20-mil.gal. capacity, in 1928.

The Springwells Station

The Springwells Station, at Warren Ave. and the Detroit Terminal Railroad (west section of city), went into operation, as a complete station, in 1935. It covers a site containing approximately 44 acres. Included in the station are the low-lift plant, high-lift plant, power plant, coagulation or sedimentation basin, filtration plant and filtered water reservoirs.

The low-lift plant contains eight main and two auxiliary motor-driven centrifugal pumping units. The total rated capacity of this plant is 435 mgd. against a 60-ft. head. The 12-ft. diameter tunnel, from the intake previously described, terminates at the low-lift plant, from which the raw water flows by gravity through the mixing chamber to the coagulation basin.

The coagulation or sedimentation basins are in four units, each 135 ft. by 340 ft. in plan, with a total depth of 23 ft. The basins are of reinforced concrete, on pile foundations.

The filtration plant contains 68 rapid sand filters with a maximum rate of 4.5 mgd. each, and each is $\frac{1}{40}$ of an acre in area. The filters are of reinforced concrete construction, on pile foundations, and all appurtenant piping, valves and drains are of cast iron. The superstructure is of reinforced concrete and structural steel construction and is faced with limestone. There are two underground filtered water reservoirs, each with a capacity of 20 mil.gal. They are of reinforced concrete construction on piling. The high-lift station pumps water from the filter plant or from the filtered water reservoirs directly into the mains.

There are 16 pumps in 8 pump pits, 2 in each, of rated capacities ranging from 17 to 50 mgd. each. Four of these pumps are driven by slip-ring motors, and 12 by synchronous motors of from 700 to 1,725 hp. The total rated capacity of the high-lift pumps is 568 mgd. The substructure of the high-lift plant is of reinforced concrete, with pile foundation, and the superstructure is of structural steel and reinforced concrete, faced with limestone.

Power for Springwells Station is produced in a steam turbo-generator plant, adjacent to the pumping station, with two standby feeder lines from central stations. The present installation consists of two boiler units each with a maximum output of 90,000 lb. of steam per hour. These units are coal-fired by underfeed stokers. There are presently installed two 5,000-kw. main, and three 500-kw. auxiliary, turbo-generators. The main units are

15-stage, turning 3,600 rpm., designed for 350-psi. gage pressure and 700°F. steam temperature, with 4,600-volt, 3-phase, 60-cycle generators.

There have been no retirements of major components of the Springwells Station to date.

System Structures

The Detroit water system is divided into four separate pressure zones or districts: Water Works Park High Pressure, Springwells High Pressure, Intermediate Pressure and Low Pressure. Both stations pump directly into the intermediate zone; and Water Works Park Station, only, pumps into the low pressure zone. The maximum station pressure for each zone follows:

Water Works Park High	90 psi.
Springwells High	90 psi.
Water Works Park Intermediate	85 psi.
Springwells Intermediate	70 psi.
Water Works Park Low	58 psi.

There are five elevated steel storage tanks which "ride" the system at or near the corporate limits. Three of these tanks are in the high pressure zones and two in the intermediate. These tanks are all in service and none have as yet been retired. The data on these tanks follows:

Designation	Placed in Service year	Capacity mil gal.	Plate Thickness in.
Northern*	1929	1.5	1
Northwestern*	1931	2.0	1
Redford*	1928	1.5	$\frac{3}{4}$
Plymouth†	1927	1.5	$\frac{7}{8}$
Dearborn†	1928	1.5	$\frac{3}{4}$

* Springwells High Pressure Zone.

† Intermediate Pressure Zone.

Group A Facilities Included

The compilation of installation and retirement data pertaining to Group A facilities has been completed for trans-

mission and distribution mains, a summary of which is given in Table 1. Comparable studies on the distribution meters throughout the system are still in progress.

Distribution valves and hydrants have been excluded from the survey. Records of valves do not afford data applicable to study of survival and retirement.

The original installation of a valve at each location usually has been noted; but replacements have been reported quantitatively rather than by locations. Total replacements of valves have been avoided when possible to make repairs by substitution of parts in the field. Valves removed and repaired have been mingled with new stock and subsequently reinstalled in the system without special identification. Valves salvaged from abandoned mains similarly have been returned to stock and re-used.

Fire hydrants were installed by the Board of Fire Commissioners until 1940. The Board of Water Comrs.' records cover locations of hydrants only. Repair and salvage practices similar to those described for valves preclude the possibility of assembling significant installation and retirement data.

Significance of Data

An appraisal of the records from which data respecting mains were drawn is essential to correct evaluation of the data. Reviewing these records in the light of a knowledge of contemporary practices it is manifest that the physical durability of materials is little reflected. Statistical analysis of these data, directed toward determination of the physical serviceability of installations, might produce grossly false conclusions.

It is, for instance, not unusual for excavations in the streets to expose sections of bored log mains, as sound as when they were laid, although the last of these mains was disconnected from the system half a century ago because of unsuitability for increasing pressures. On the other hand, the records show, as still in service, mains of much younger age, where it is known that by repeated repair and maintenance operations much of the original pipe has been replaced.

Causes of retirements are generally unrecorded. Only a relatively small percentage, however, have been due solely to physical deterioration. Many entirely serviceable mains have been abandoned to accommodate improvements and alterations extraneous to the water system. At the same time many a long contemplated replacement of a small main with one of larger size has finally been accomplished when the frequency of repairs required in the existing pipe became excessive.

The majority of abandoned mains have been disconnected and left in the ground without consideration of the age or condition of the pipe. When construction operations have made salvaging of pipe practicable, the serviceable material has been returned to stock and re-used without being distinguished from new.

Under these conditions it should be emphasized that Detroit retirement and survival data show primarily the length of time through which a facility once installed has continued to be required in its original location and size. The data reflect largely factors peculiar to Detroit, such as the rates of geographical expansion, population increase and industrial development, combined with rising standards for adequacy of water supply.

TABLE 1
SUMMARY OF MAINS—DETROIT, MICHIGAN

Size, <i>in.</i>	Kind	Number of Feet Installed	Number of Feet Identified	Per- cent- age of Total	Number of Feet Retired	Per- cent- age of Total	Number of Feet in Service	Per- cent- age of Total	Year of First Instal- lation	Aver- age Age, <i>yr.</i>
4	Cast-iron unlined	1,463,894	1,075,394	6.6	856,624	64.3	218,770	1.5	1854	46.9
6		6,666,297	6,462,692	39.7	251,649	18.9	6,211,043	41.6	1854	27.3
8		5,156,071	5,090,496	31.2	109,535	8.2	4,980,961	33.3	1840	21.1
10		307,680	292,189	1.8	25,599	1.9	266,590	1.8	1854	42.4
12		1,119,697	1,119,697	6.9	20,181	1.5	1,099,516	7.4	1860	19.8
16		496,091	496,091	3.1	12,924	1.0	483,167	3.2	1854	21.8
18		103	103	0.0	103	0.0	0	0.0	1883	—
20		348	348	0.0	61	0.0	287	0.0	1883	44.5
24		579,381	579,381	3.6	19,518	1.5	559,863	3.8	1854	22.5
30		137,414	137,414	0.8	2,560	0.2	134,854	0.9	1858	30.5
36	Universal cast-iron unlined	225,126	225,126	1.4	404	0.0	224,722	1.5	1890	15.8
42		184,992	184,992	1.1	2,444	0.2	182,548	1.2	1875	36.8
48		179,138	179,138	1.1	1,444	0.1	177,694	1.2	1908	28.3
8	Cast-iron cement- lined	36,452	36,452	0.2	4,577	0.3	31,875	0.2	1921	15.1
12		65,298	65,298	0.4	2,043	0.2	63,255	0.4	1921	21.1
16		31,719	31,719	0.2	105	0.0	31,614	0.2	1921	19.8
8	Steel, bitu- minous lined and coated	1,845	1,845	0.0	0	0	1,845	0.0	1941	1.5
24		495	495	0.0	0	0	495	0.0	1941	1.5
12		28,064	28,064	0.2	9,834	0.7	18,230	0.1	1920	21.4
16	Toncan iron, bituminous lined and coated	26,339	26,339	0.2	5,596	0.4	20,743	0.1	1922	20.1
24		10,402	10,402	0.1	7,542	0.6	2,860	0.0	1921	20.8
30		75	75	0.0	0	0	75	0.0	1928	14.5
36	Armco iron, bituminous lined and coated	5,572	5,572	0.0	0	0	5,572	0.0	1922	19.4
42		20,462	20,462	0.1	0	0	20,462	0.1	1925	15.7
44		20,893	20,893	0.1	0	0	20,893	0.1	1926	16.5
48	Asbestos- cement	88,382	88,382	0.5	190	0.0	88,192	0.6	1920	19.0
50		2,633	2,633	0.0	0	0	2,633	0.0	1927	15.5
54		594	594	0.0	0	0	594	0.0	1927	14.5
60	TOTAL	36,437	36,437	0.2	0	0	36,437	0.3	1926	15.5
66		7,554	7,554	0.1	0	0	7,554	0.1	1930	11.5
72		34,457	34,457	0.2	0	0	34,457	0.2	1927	11.5
36	Percentage of Total	4,688	4,688	0.0	0	0	4,688	0.0	1931	11.5
42		1,072	1,072	0.0	0	0	1,072	0.0	1932	10.5
54		17,696	17,696	0.1	0	0	17,696	0.1	1929	13.0
66	Average Size, <i>in.</i>	14,548	14,548	0.1	0	0	14,548	0.1	1930	12.5
8		1,605	1,605	0.0	0	0	1,605	0.0	1937	4.0
	TOTAL	16,973,514	16,300,343	100.0	1,332,933	100.0	14,967,410	100.0		24.6
	Percentage of Total		100.0		8.2		91.8			
	Average Size, <i>in.</i>		10.24		5.79		10.64			

TABLE 1 (contd.)
Mortality Survival Ratios

Size, in.	Kind	No of Feet	Period Covered, yr.	Percentage
4	Cast-iron unlined	1,075,394	88.5	3.717
6		6,462,692	88.5	31.460
8		5,126,948	102.5	75.111
10 and 12		1,477,184	88.5	68.216
Over 12		1,834,312	88.5	84.620
8-24	Cast-iron cement-lined	2,340	1.5	100.000
12-72	Steel and iron, bituminous lined and coated	319,868	22.5	83.496
8	Asbestos-cement	1,605	5.5	100.000
TOTAL		16,300,343		

Basis of Survey

A brief description of the distribution system will assist the explanation of the extent and limitations of the data pertaining to mains.

The Dept. of Water Supply furnishes water to the entire city of Detroit and to 36 surrounding cities, villages and townships. Population served is: Detroit, 1,775,000; Suburban, 523,000; a total of 2,298,000. Area served is: Detroit, 140 square miles; Suburban, 135 square miles; a total of 275 square miles.

Suburban communities construct their own mains. In the past, the department maintained many of the suburban systems, installing service connections and collecting from individual customers. Today, with three minor exceptions, the suburbs perform their own maintenance and handle their own customer accounts, purchasing water from Detroit at quantity rates.

At the date of report, Detroit water was supplied through 4,900 miles of mains, of which 2,894 miles were included in the water system of the corporate city of Detroit, the remainder comprising the suburban distribution systems.

The Board of Water Comrs. reserves the right to approve plans and inspect construction of suburban main extensions and has practically a complete record of such construction. Most of the present suburban systems, however, are comparatively young, and it is felt the slight value of installation and retirement information respecting their mains would not justify the labor involved in assembling the data. The survey of mains, therefore, has been limited to the installations within the city limits and to those Detroit-owned transmission mains which traverse adjacent territory in connecting outlying sections of the city.

At the date of report the total number of services supplied with Detroit water was approximately 410,000, of which 314,000 were within the city and 96,000 were suburban.

Sources of Data for Transmission and Distribution Mains

No separation is made of transmission mains and distribution mains in the data. Today, in general, mains of 24-in. and greater diameter are treated as transmission mains and are not tapped for ordinary service connec-

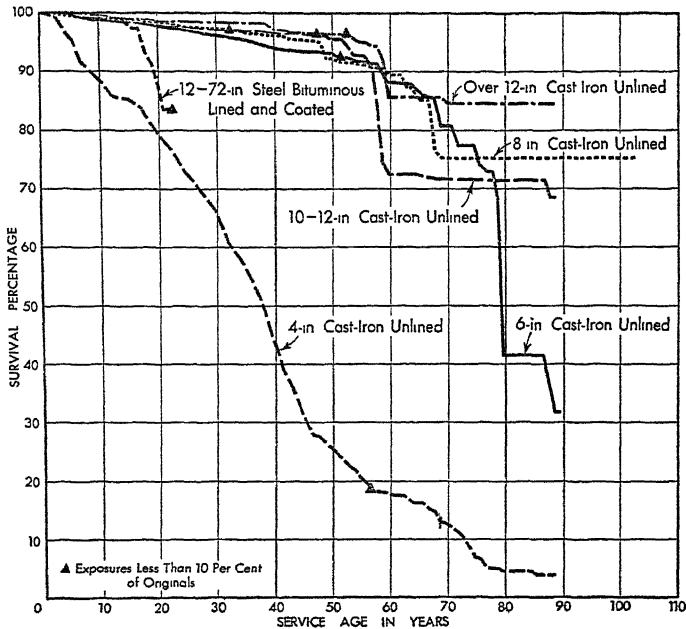


FIG. 1. Mortality Survival Curve—4-72-in. Mains—Detroit, Michigan

BASE: Feet SIZE in.	KIND	SURVIVAL: 1840-1942	
		EXPOSURES ft.	RETIREMENTS ft.
4	Cast-Iron Unlined	1,075,394	856,624
6		6,462,692	251,649
8		5,126,948	114,112
10 and 12		1,477,184	47,823
Over 12	Steel	1,834,312	39,563
12-72		319,868	23,162

tions. There are some exceptions to this rule, and, of course, many smaller transmission mains of the past have, by evolution, become distribution mains.

The records of mains laid under the jurisdiction of the Board of Water Comrs. are practically complete, from 1854 to date. Under date of December 31, 1853, in the first annual report of the Board, the Supt. and Engr. of Water Works reported a total of 14,434 ft. of 3-in. to 16-in. iron pipes in the system, of which 6,443 ft. had been laid in 1853. He included a map show-

ing the location and size of each iron main, but did not indicate which were of the previous year's construction. This map is the prime record of mains laid prior to 1854.

From 1854 to 1867 the published annual reports of the Board detailed each year's construction, as well as scheduling all mains in the system, showing kind, size and location. Beginning in 1868, the itemized descriptions of new construction were dropped from the annual reports. The listed descriptions of the entire system were continued,

and construction operations of the years 1868-70 must be deduced from the annual additions to the lists.

Beginning in 1871 there are preserved journals kept by the "Supt. of Extensions and Repairs." In these, day-to-day entries described the mains added and changes made. The first record of main retirement appears in the journal of 1872.

These journals continue through 1894. From 1889 through 1894 there are also preserved field books kept by the individual construction foremen.

During 1894 the Engineering Div. of the Dept. of Water Supply made surveys, recorded by dimensioned sketches in standard survey notebooks, of some of the current main construction. From 1895 to date the Engineering Div. has made "as built" surveys of all new construction and alterations of existing mains. The field notebooks, after the surveys contained are posted on the maps of the system, are filed by years, with a geographically arranged card index maintained to facilitate the tracing of all notes relative to each location.

Mortality Survival Study

Mortality studies of mains only are included in this report. Table 1 is a

summary of the pipe installed and retired. Figure 1 shows the mortality survival curves covering the record of the amount and sizes of pipe grouped as shown.

Acknowledgment

The collection and compilation of the data relative to the installation and retirement of mains in Detroit were made under the general direction of L. G. Lenhardt, Gen. Mgr., Board of Water Comrs., a member of the Executive Com. of the A.W.W.A. Com. on Survival and Retirement Experience With Water Works Facilities. L. V. Garrity, Asst. Gen. Supt. was in charge of abstracting and compiling the records.

SUMMARY OF INSTALLATIONS AND RETIREMENTS

DETROIT, MICHIGAN

MAINS

4-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet			Year Installed	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1854	43,252	5,016	38,236	1881	15,630	1,091	14,539
1855	11,801	2,794	9,007	1882	24,483	3,027	21,456
1856	26,216	2,425	23,791	1883	14,829	3,479	11,350
1857	1,342	0	1,342	1884	45,225	6,765	38,460
1858	757	48	709	1885	74,043	13,608	60,435
1859	1,585	96	1,489	1886	63,799	12,895	50,904
1860	746	0	746	1887	63,258	9,570	53,688
1861	895	0	895	1888	68,018	10,475	57,543
1862	690	0	690	1889	69,242	9,139	60,103
1863	1,755	474	1,281	1890	50,480	6,877	43,603
1865	1,499	0	1,499	1891	69,465	18,121	51,344
1866	600	0	600	1892	47,907	13,697	34,210
1867	1,736	0	1,736	1893	14,696	3,530	11,166
1869	937	0	937	1894	5,259	2,587	2,672
1871	6,107	4	6,103	1895	7,979	6,263	1,716
1872	13,244	739	12,505	1896	2,248	688	1,560
1873	17,594	5,297	12,297	1897	2,531	2,330	201
1874	19,607	1,907	17,700	1898	9,436	1,416	8,020
1875	6,931	348	6,583	1899	8,468	2,996	5,472
1876	11,776	13	11,763	1900	5,609	1,332	4,277
1877	6,795	419	6,376	1901	3,510	1,170	2,340
1878	6,593	293	6,660	1902	40,195	6,480	33,715
1879	15,390	62	15,328	1903	6,678	902	5,776
1880	13,465	3,545	9,920	1904	1,202	947	255

SURVIVAL AND RETIREMENT

4-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1905	6,805	643	6,162	1923	38,250	4,866	33,384
1906	632	0	632	1924	40,494	23,872	16,712
1908	19	0	19	1925	1,946	563	1,383
1909	1,589	460	1,129	1926	382	369	13
1910	213	0	213	1927	169	98	71
1911	780	780	0	1928	201	93	108
1912	246	0	246	1929	49	32	17
1913	16	0	16	1930	64	43	21
1914	2,858	2,858	0	1935	18	0	18
1915	1,159	789	370	1941	59	59	0
1916	1,553	691	862	1942	75	75	0
1919	3,132	2,582	550				
1920	1,326	0	1,326	SUBTOTAL	1,075,394	218,770	856,624
1921	3,363	3,363	0	Unknown	388,500	85,070	303,430
1922	44,133	13,759	30,374				
				TOTAL	1,463,894	303,840	1,160,054

Retirements by Years

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1854	331	1872	544	1879	1,182	1884		1866	331	1927	269	1930		
	424	1885	166	1886	121	1890		1867	508	1884	399	1894	427	1905
	540	1891	1,299	1892	2,028	1893			402	1930				
	4,136	1884	183	1895	700	1896		1869	937	1940				
	1,090	1898	48	1902	200	1903		1871	130	1892	1,487	1894	691	1897
	279	1904	2,798	1905	1,516	1908			436	1904	224	1908	267	1910
	384	1910	4,422	1911	505	1917			556	1921	345	1923	23	1926
	583	1920	365	1921	2,078	1922			1,389	1927	34	1928	485	1930
	286	1923	874	1924	402	1925			36	1935				
	312	1926	3,719	1927	1,645	1928		1872	65	1877	27	1878	5,581	1883
	1,051	1929	3,639	1930	64	1932			54	1887	516	1892	740	1893
	37	1934	275	1941					170	1884	298	1895	1,066	1921
1855	194	1902	64	1903	2,042	1911			1,028	1922	1,198	1924	25	1925
	2,105	1921	124	1924	257	1925			1,235	1927	391	1929	29	1930
	325	1926	1,496	1927	65	1929			23	1937	59	1941		
	510	1930	360	1934	1,465	1935		1873	227	1886	1,434	1894	205	1895
1856	570	1885	594	1890	208	1891			725	1903	333	1905	62	1907
	1,075	1892	370	1893	2,563	1894			633	1910	1,162	1911	26	1912
	142	1903	350	1905	1,723	1908			1,121	1913	513	1919	601	1921
	265	1909	2,042	1910	950	1912			68	1922	1,045	1923	771	1924
	208	1915	460	1920	155	1922			215	1925	1,119	1926	1,556	1927
	4,995	1924	586	1926	391	1927			182	1928	155	1929	60	1930
	856	1928	485	1929	3,563	1930			38	1938	46	1941		
	61	1932	1,179	1941				1874	517	1874	42	1879	391	1883
1857	500	1903	105	1904	222	1921			32	1892	3,750	1893	1,809	1894
	265	1927	250	1930					1,112	1896	1,021	1898	36	1903
1858	63	1884	646	1924					884	1908	654	1909	434	1910
1859	303	1878	321	1895	129	1896			1,777	1911	830	1912	167	1921
	174	1897	562	1903					454	1922	667	1924	833	1926
1860	450	1890	61	1892	235	1927			496	1927	293	1929	253	1930
1861	621	1921	274	1927					24	1931	32	1932	73	1933
1862	690	1930							48	1934	49	1935	33	1936
1863	85	1888	220	1903	364	1911			956	1937	29	1941		
	491	1926	121	1930				1875	18	1886	78	1888	2,040	1890
1865	1,000	1895	315	1905	184	1921			668	1898	60	1906	245	1908

4-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1875	379	1910	548	1911	350	1912		1882	43	1934	510	1941		
	503	1913	384	1921	548	1927		1883	16	1883	118	1888	47	1890
	354	1929	280	1930	128	1941			29	1891	851	1892	1,231	1893
1876	23	1882	150	1883	831	1885			1,242	1894	251	1895	180	1896
	60	1890	60	1892	116	1894			29	1897	187	1905	47	1907
	33	1907	692	1909	60	1911			26	1908	66	1909	133	1910
	760	1912	55	1919	47	1920			2,029	1911	1,460	1912	474	1913
	667	1921	523	1922	16	1926			271	1914	24	1915	16	1917
	22	1927	22	1928	1,055	1929			141	1920	252	1921	57	1923
	4,852	1930	865	1931	437	1933			214	1924	359	1925	46	1927
	417	1936							42	1928	1,486	1929	26	1930
1877	32	1877	18	1884	46	1887			20	1933				
	98	1889	95	1892	567	1893		1884	772	1884	640	1886	833	1890
	131	1895	70	1896	43	1898			313	1891	250	1892	497	1893
	98	1907	137	1909	59	1910			4,832	1894	24	1895	1,996	1896
	424	1911	154	1912	440	1919			45	1898	32	1899	57	1904
	135	1921	80	1923	115	1924			12	1905	667	1906	477	1907
	632	1925	541	1926	870	1927			1,461	1908	1,243	1909	1,527	1910
	339	1928	58	1929	973	1930			3,109	1911	39	1912	468	1913
	60	1931	26	1934	40	1935			159	1914	352	1917	318	1920
	95	1941							2,374	1921	61	1922	743	1923
1878	47	1890	1,176	1898	450	1908			2,644	1924	967	1925	515	1926
	33	1909	47	1919	1,077	1921			1,868	1927	3,589	1928	1,812	1929
	230	1923	27	1924	163	1925			3,555	1930	159	1931	50	1934
	191	1926	1,147	1927	1,283	1928		1885	711	1886	37	1887	212	1888
	197	1929	562	1930	30	1933			25	1890	2,731	1892	297	1893
1879	34	1887	26	1893	137	1894			3,003	1894	2,344	1895	1,094	1896
	1,080	1895	378	1896	1,044	1898			648	1898	55	1900	542	1905
	1,019	1908	567	1909	35	1911			922	1907	1,764	1908	596	1909
	56	1912	103	1921	67	1923			480	1910	2,842	1911	1,585	1912
	152	1924	154	1926	519	1927			368	1914	853	1915	1,405	1919
	1,431	1928	3,576	1929	765	1930			2,143	1920	4,677	1921	413	1922
	2,845	1931	548	1933	792	1934			324	1923	4,248	1924	929	1925
1880	265	1881	27	1891	40	1892			956	1926	623	1927	6,205	1928
	35	1903	365	1908	297	1912			3,986	1929	8,353	1930	4,287	1931
	397	1915	681	1919	1,126	1922			146	1934	21	1938	216	1940
	2,197	1923	1,042	1924	765	1925			334	1941				
	2,061	1928	600	1930	22	1936		1886	439	1892	1,595	1893	2,739	1894
1881	300	1890	172	1892	290	1893			899	1895	416	1896	3,984	1897
	483	1898	938	1907	598	1908			708	1898	55	1899	180	1905
	368	1910	3,617	1911	480	1912			300	1906	219	1907	359	1908
	487	1915	65	1920	3,397	1921			1,044	1909	33	1910	2,756	1911
	12	1924	750	1927	301	1928			330	1912	763	1913	755	1919
	362	1929	941	1930	430	1931			2,059	1920	10,190	1921	952	1922
	548	1933							1,534	1923	1,077	1924	2,405	1925
1882	511	1886	243	1892	825	1893			2,077	1926	1,744	1927	1,613	1928
	871	1894	76	1896	1,795	1898			2,180	1929	5,499	1930	1,544	1931
	33	1899	19	1904	1,200	1905			12	1932	61	1933	155	1940
	647	1908	1150	1910	228	1911			228	1941				
	390	1912	40	1913	832	1914		1887	65	1889	2,851	1892	271	1893
	37	1915	826	1916	26	1920			1,511	1894	1,010	1895	629	1896
	2,008	1921	37	1922	179	1924			686	1898	456	1899	60	1901
	133	1925	771	1926	1,690	1927			45	1902	595	1905	170	1906
	3,098	1928	1,510	1929	1,728	1930			231	1907	2,041	1908	5,167	1909

SURVIVAL AND RETIREMENT

4-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year						Year					
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year
1887	696	1910	1,086	1911	2,855	1913	1892	223	1898	37	1899
	750	1916	1,571	1919	473	1920		67	1904	33	1905
	4,958	1921	1,694	1922	1,258	1923		433	1907	620	1908
	2,431	1925	592	1926	2,499	1927		146	1910	1,288	1911
	2,542	1928	2,104	1929	10,867	1930		1,390	1913	166	1914
	1,019	1931	505	1933				539	1916	1,562	1919
1888	327	1889	1,153	1892	2,248	1893		2,145	1921	969	1922
	5,057	1894	94	1895	2,281	1898		406	1924	948	1925
	433	1901	1,334	1903	531	1905		1,463	1927	2,101	1928
	650	1906	427	1907	563	1908		10,123	1930	230	1931
	2,362	1909	1,561	1910	4,373	1911		1,123	1940	879	1941
	1,261	1912	1,145	1913	346	1915	1893	24	1893	24	1896
	976	1919	1,633	1920	3,456	1921		80	1907	160	1909
	1,857	1922	2,499	1924	1,353	1925		926	1911	72	1913
	1,218	1926	473	1927	3,372	1928		466	1920	315	1921
	1,451	1929	6,365	1930	2,988	1931		100	1924	1,095	1925
	3,486	1933	35	1934	235	1941		505	1927	422	1928
1889	113	1892	125	1893	693	1894		6,546	1930		71
	233	1895	2,175	1896	739	1898	1894	24	1908	140	1912
	43	1903	836	1906	496	1907		211	1923	843	1924
1889	655	1909	156	1910	1,786	1911		76	1929	580	1930
	2,660	1912	30	1913	313	1914		66	1942		
	383	1917	515	1919	7,398	1920	1895	174	1907	45	1910
	4,445	1921	1,353	1922	103	1923		26	1922	298	1923
	464	1924	1,725	1925	888	1926		302	1927	148	1929
	2,712	1927	9,287	1928	9,006	1929	1896	190	1898	682	1921
	6,247	1930	2,286	1931	1,685	1933		397	1928		291
	36	1934	41	1937	476	1941	1897	22	1913	179	1928
1890	165	1891	344	1892	1,621	1894	1898	758	1907	208	1909
	1,339	1896	735	1898	245	1903		953	1921	310	1922
	183	1904	122	1905	203	1906		650	1926	777	1928
	254	1907	294	1908	862	1909		506	1937		2,242
	173	1910	1,148	1911	168	1912	1899	472	1906	305	1912
	2,270	1913	1,087	1914	1,301	1919		510	1920	286	1921
	2,879	1920	10,541	1921	303	1922		1,077	1923	854	1927
	542	1923	1,740	1924	761	1925	1900	126	1912	562	1919
	157	1926	824	1927	1,343	1928		385	1922	83	1928
	477	1929	6,714	1930	2,134	1931	1901	493	1920	389	1927
	1,229	1933	81	1936	766	1937		1,157	1930		301
	598	1941					1902	522	1906	1,432	1908
1891	127	1892	400	1893	552	1894		2,384	1911	539	1912
	604	1895	330	1896	39	1899		2,211	1919	2,848	1920
	244	1901	11	1903	88	1905		1,599	1922	3,165	1923
	1,018	1906	1,016	1907	669	1908		859	1925	324	1926
	1,202	1909	1,156	1910	628	1911		594	1928	2,097	1929
	132	1912	1,343	1913	1,163	1914		200	1931	265	1938
	31	1915	21	1918	818	1919		274	1942		26
	137	1920	11,626	1921	929	1922	1903	36	1912	655	1913
	101	1923	1,929	1924	1,567	1925		664	1921	913	1922
	766	1926	444	1927	1,767	1928		350	1925	785	1929
	5,246	1929	7,968	1930	1,546	1931		105	1916	150	1920
	1,654	1932	1,796	1933	81	1934	1904	18	1921	1,763	1922
	664	1937	1,531	1941			1905	1,500	1929	2,142	1930
1892	38	1893	896	1894	192	1895					

4-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1906	632	1926							1922	227	1922	428	1924	3,726	1927
1908	19	1928							18,428	1928	1,396	1929	2,885	1930	
1909	1,118	1919	11	1926					678	1938	2,606	1939			
1910	13	1922	200	1923					1,146	1926	11,016	1927	1,351	1928	
1911									3,816	1929	2,574	1930	908	1939	
1912	246	1929							7,059	1940	5,514	1941			
1913	16	1927							1,712	1926	11,971	1927	2,889	1928	
1914									140	1929					
1915	177	1920	156	1921	37	1928			1,362	1927	21	1930			
1916	62	1921	800	1925					13	1930					
1919	187	1922	128	1927	32	1928			1927	23	1929	48	1930		
	203	1930							1928	16	1928	58	1929	34	1931
1920	32	1923	143	1926	515	1928			1929	17	1930				
	636	1929							1930	21	1931				
1921									1935	18	1937				

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1854	7,912	2,672	5,240	1897	41,794	39,040	2,754
1856	394	288	106	1898	88,774	81,568	7,206
1859	558	558	0	1899	37,003	34,999	2,004
1860	738	738	0	1900	9,596	7,644	1,952
1864	1,266	0	1,266	1901	26,215	24,964	1,251
1867	4,216	2,173	2,043	1902	82,063	71,387	10,676
1868	5,382	4,804	578	1903	29,662	28,649	1,013
1869	73	73	0	1904	39,554	37,989	1,565
1871	753	290	463	1905	64,423	62,284	2,139
1872	7,687	4,032	3,655	1906	73,779	71,438	2,341
1873	25,152	17,010	8,142	1907	86,525	83,944	2,581
1874	14,349	10,533	3,816	1908	39,237	37,483	1,754
1875	25,655	23,551	2,104	1909	50,886	49,474	1,412
1876	14,060	12,758	1,302	1910	61,457	60,755	702
1877	23,955	22,141	1,814	1911	41,898	39,504	2,394
1878	7,296	5,447	1,849	1912	45,298	44,793	505
1879	21,010	18,563	2,447	1913	47,621	47,074	547
1880	4,268	4,178	90	1914	67,539	65,864	1,675
1881	6,918	6,250	668	1915	131,544	125,205	6,339
1882	20,932	17,654	3,278	1916	154,872	151,237	3,635
1883	14,347	12,026	2,321	1917	321,217	310,141	11,076
1884	12,760	11,009	1,751	1918	160,062	157,684	2,378
1885	29,962	26,935	3,027	1919	241,347	239,489	1,858
1886	106,598	93,371	13,227	1920	253,332	248,619	4,713
1887	101,601	90,077	11,524	1921	234,029	229,222	4,807
1888	59,665	55,386	4,279	1922	174,961	171,940	3,021
1889	70,958	64,865	6,093	1923	366,694	358,696	7,998
1890	33,805	31,378	2,427	1924	394,669	388,355	6,314
1891	75,767	70,102	5,665	1925	422,896	419,154	3,742
1892	94,278	89,033	5,245	1926	453,980	445,719	8,261
1893	112,358	91,824	20,534	1927	580,217	577,632	2,585
1894	135,525	118,863	16,662	1928	186,987	185,143	1,844
1895	51,343	48,816	2,527	1929	139,704	138,562	1,142
1896	44,164	42,265	1,899	1930	70,556	69,169	1,387

SURVIVAL AND RETIREMENT

6-IN. CAST-IRON UNLINED MAINS (contd.)

Year				Year			
		Feet				Feet	
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1931	33,541	33,541	0	1940	12,382	12,382	0
1932	2,727	2,727	0	1941	15,000	15,000	0
1933	844	844	0	1942	3,879	3,879	0
1934	1,330	1,330	0				
1935	173	137	36	SUBTOTAL	6,462,692	6,211,043	251,649
1936	3,192	3,192	0	Unknown	203,605	163,509	40,096
1937	4,501	4,501	0				
1938	8,903	8,903	0	TOTAL	6,666,297	6,374,552	291,745
1939	20,124	20,124	0				

Retirements by Years

Year							Year						
		Feet							Feet				
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1854	510	1929	610	1932	3,281	1933	1886	202	1910	714	1911	20	1912
	839	1941						78	1913	600	1915	2,369	1920
1856	106	1932						66	1921	289	1922	1,313	1925
1864	24	1892	1,242	1929				28	1927	357	1928	151	1930
1867	1,319	1931	724	1938				144	1931	65	1932	66	1933
1868	127	1927	451	1936				757	1934	1,917	1936	26	1937
1871	300	1905	163	1910				320	1938	704	1939	86	1941
1872	264	1910	186	1930	3,056	1931	1887	40	1890	270	1892	1,374	1893
	48	1936	101	1937				2,455	1907	218	1908	324	1909
1873	2,172	1894	300	1910	1,229	1912		692	1910	1,631	1911	1,158	1913
	266	1923	197	1924	26	1928		585	1921	399	1925	438	1928
	1,185	1931	2,767	1941				11	1929	800	1930	122	1931
1874	31	1879	515	1883	1,629	1894		12	1937	558	1938	60	1939
	957	1912	539	1931	67	1934		377	1941				
	42	1937	36	1941			1888	54	1890	24	1892	40	1893
1875	327	1909	728	1910	40	1920		32	1894	970	1908	321	1911
	406	1925	577	1926	26	1941		278	1912	1,046	1913	122	1915
1876	1,302	1931						170	1919	61	1922	549	1925
1877	50	1890	50	1895	417	1897		55	1926	180	1930	73	1936
	1,121	1911	107	1941				70	1938	234	1941		
1878	178	1890	1,562	1936	72	1937	1889	310	1895	700	1901	260	1906
	37	1938						531	1910	609	1915	490	1916
1879	28	1882	249	1893	1,320	1910		652	1920	2,128	1925	33	1933
	680	1921	170	1941				83	1936	106	1938	191	1941
1880	60	1920	30	1935			1890	222	1903	311	1905	33	1907
1881	570	1909	51	1921	47	1941		526	1925	1,015	1926	40	1927
1882	370	1896	153	1901	248	1905		78	1931	94	1936	108	1941
	460	1909	917	1910	837	1919	1891	127	1893	58	1894	144	1900
	186	1929	107	1941				63	1905	258	1907	189	1909
1883	640	1896	26	1901	519	1907		204	1915	704	1918	273	1920
	20	1909	49	1920	224	1921		1,766	1921	57	1922	368	1925
	30	1924	613	1932	200	1941		920	1926	64	1935	68	1936
1884	887	1893	65	1894	333	1911		367	1939	35	1941		
	71	1922	220	1929	108	1934	1892	49	1894	938	1895	146	1900
	67	1936						25	1901	142	1905	67	1907
1885	44	1905	596	1907	85	1921		37	1909	742	1910	938	1911
	28	1925	160	1929	27	1932		76	1912	46	1915	270	1920
	1,576	1936	511	1941				26	1922	42	1924	581	1925
1886	45	1890	144	1891	51	1894		95	1926	12	1930	36	1931
	398	1897	1,087	1904	588	1905		100	1936	458	1939	67	1940
	348	1907	93	1908	201	1909		352	1941				

6-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

<i>Year</i>						<i>Year</i>					
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1893	26	1896	216	1898	2,064	1904	1904	51	1924	42	1933
	1,881	1905	1,326	1906	325	1907		77	1939	58	1936
	726	1910	2,050	1911	49	1912	1905	41	1907	269	1909
	951	1913	104	1914	330	1916		358	1920	64	1921
	74	1917	750	1920	1,483	1921		272	1925	54	1928
	300	1922	220	1925	350	1926		169	1930	91	1939
	480	1927	1,970	1928	431	1929	1906	234	1907	41	1908
	3,471	1930	81	1931	530	1936		266	1911	242	1916
	158	1939	188	1940				92	1924	52	1928
1894	30	1894	222	1895	16	1896		344	1930	108	1938
	2,635	1905	92	1906	759	1907		22	1940		
	127	1908	918	1909	1,659	1910	1907	50	1910	437	1911
	2,030	1911	31	1919	2,008	1920		90	1921	214	1923
	318	1921	1,162	1922	28	1923		57	1928	80	1929
	391	1924	443	1925	190	1927		37	1936	377	1937
	21	1929	878	1930	155	1931		474	1941		
	1,863	1934	164	1936	81	1939	1908	237	1911	229	1913
	441	1941						70	1926	549	1929
1895	491	1895	531	1901	232	1906		87	1936	187	1939
	540	1907	94	1924	366	1925	1909	532	1911	159	1915
	45	1926	140	1930	29	1931		105	1934	81	1939
	59	1939					1910	123	1911	153	1912
1896	43	1898	48	1908	127	1909		153	1921	121	1937
	245	1910	97	1911	15	1914	1911	220	1920	68	1925
	20	1917	190	1921	100	1928		1,931	1928	5	1929
	85	1929	85	1933	140	1936	1912	36	1928	28	1929
	568	1938	138	1939				389	1939		
1897	15	1900	26	1908	1,960	1910	1913	65	1918	185	1926
	50	1911	492	1912	15	1926		2	1929	274	1931
	61	1928	51	1929	84	1930	1914	221	1920	21	1921
1898	1,018	1900	350	1904	1,090	1905		156	1931	63	1934
	959	1906	44	1910	43	1912	1915	874	1920	13	1921
	627	1914	716	1920	860	1921		2,039	1923	1,341	1924
	752	1926	28	1928	57	1934		390	1927	923	1928
	80	1935	66	1936	516	1937		58	1932	25	1940
1899	226	1906	176	1910	277	1911	1916	125	1918	180	1921
	226	1913	574	1920	272	1921		1,053	1923	1,354	1924
	21	1925	39	1926	85	1934		122	1928	319	1929
	108	1938						47	1939		
1900	174	1904	271	1906	1,050	1907	1917	103	1919	396	1920
	52	1930	405	1939				256	1922	436	1923
1901	108	1905	80	1911	155	1925		479	1925	161	1927
	228	1929	30	1931	56	1939		873	1941		
	594	1941					1918	42	1921	910	1922
1902	145	1905	460	1906	389	1907		306	1926	68	1928
	1,591	1908	1,692	1911	196	1912		52	1939	11	1941
	320	1915	2,500	1920	1,435	1921	1919	689	1921	173	1923
	596	1923	175	1924	410	1925		237	1928	18	1931
	641	1929	126	1930				24	1936	248	1937
1903	278	1911	464	1912	74	1920	1920	388	1921	296	1922
	22	1924	24	1930	46	1938		1,122	1924	170	1925
	105	1939						357	1927	254	1928
1904	276	1908	164	1911	87	1912		11	1934	38	1936
	12	1913	412	1920	386	1921		34	1939	207	1940

SURVIVAL AND RETIREMENT

6-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1921	199	1921	64	1922	286	1924		1925	139	1935	788	1936	9	1939
	2,993	1925	928	1927	10	1929			35	1940	246	1941		
	148	1934	129	1938	50	1941		1926	4	1926	2,233	1928	141	1929
1922	68	1923	16	1925	245	1926			2,744	1932	13	1935	145	1936
	161	1927	2,120	1928	380	1930			2,669	1940	312	1941		
	31	1941						1927	68	1930	79	1931	22	1935
1923	168	1923	156	1924	106	1925			114	1936	36	1939	1,910	1940
	361	1926	1,642	1927	3,348	1928			356	1941				
	221	1929	652	1931	37	1935		1928	662	1928	235	1929	146	1930
	38	1937	1,269	1938					40	1931	220	1932	261	1937
1924	458	1925	392	1926	3,332	1928			280	1938				
	236	1930	154	1934	690	1938		1929	42	1929	1,089	1930	11	1939
	700	1939	186	1940	166	1941		1930	529	1930	327	1931	503	1934
1925	88	1927	81	1928	591	1929			28	1941				
	700	1930	40	1931	1,025	1934		1935	36	1941				

8-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	
1840	1,450	1,450	0	1900	1,567	1,479	88	
1854	6,463	5,143	1,320	1901	602	602	0	
1860	1,595	1,550	45	1902	7,349	3,210	4,139	
1863	32	0	32	1903	4,521	3,888	633	
1867	1,159	1,159	0	1904	9,954	9,877	77	
1868	5,185	5,185	0	1905	16,676	15,487	1,189	
1871	2,679	2,373	306	1906	17,932	17,591	341	
1872	725	725	0	1907	19,694	16,879	2,815	
1873	13,051	12,749	302	1908	21,264	20,288	976	
1874	8,638	1,125	7,513	1909	30,458	28,340	2,118	
1875	1,563	306	1,257	1910	38,457	36,329	2,128	
1877	6,956	4,455	2,501	1911	81,485	80,496	989	
1878	3,288	3,288	0	1912	76,579	76,160	419	
1879	4,765	4,765	0	1913	90,865	89,404	1,461	
1881	1,662	1,457	205	1914	62,346	62,187	159	
1882	5,625	5,261	364	1915	82,696	81,382	1,314	
1883	7,234	6,849	385	1916	72,306	71,875	431	
1884	13,252	12,665	587	1917	172,888	169,316	3,572	
1885	9,396	8,369	1,027	1918	99,367	91,509	7,858	
1886	20,171	18,841	1,330	1919	182,440	175,557	6,883	
1887	19,978	19,185	793	1920	303,174	300,249	2,925	
1888	4,503	3,168	1,335	1921	302,989	300,743	2,246	
1889	2,129	2,012	117	1922	96,255	95,688	567	
1890	14,023	13,744	279	1923	210,908	209,404	1,504	
1891	34,312	25,333	8,979	1924	483,678	480,476	3,202	
1892	28,070	26,780	1,290	1925	383,484	376,539	6,945	
1893	8,603	8,331	272	1926	507,750	502,860	4,944	
1894	47,900	40,349	7,551	1927	718,521	714,498	4,023	
1895	17,309	16,967	342	1928	173,852	173,427	425	
1896	14,431	13,991	440	1929	154,885	154,856	29	
1897	2,377	2,199	178	1930	170,250	169,871	379	
1898	13,571	10,310	3,261	1931	45,911	45,911	0	
1899	4,632	1,893	2,739	1932	7,621	7,621	0	

8-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Year</i>				<i>Feet</i>			
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1933	5,281	5,281	0	1941	32,640	32,640	0
1934	21,206	21,206	0	1942	5,086	5,086	0
1935	1,159	1,159	0				
1936	5,280	5,280	0	SUBTOTAL	5,090,496	4,980,961	109,535
1937	3,192	3,192	0	Unknown	65,575	50,160	15,415
1938	15,972	15,966	6				
1939	12,485	12,485	0	TOTAL	5,156,071	5,031,121	124,950
1940	12,744	12,744	0				

Retirements by Years

<i>Year</i>				<i>Feet</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1854	539	1891	461	1903	320	1922	
1860	45	1896					
1863	32	1896					
1871	235	1922	71	1928			
1873	118	1923	126	1925	58	1941	
1874	3,556	1893	3,957	1941			
1875	1,257	1937					
1877	1,043	1893	468	1936	990	1941	
1881	205	1904					
1882	72	1933	292	1941			
1883	289	1903	43	1929	53	1938	
1884	502	1928	52	1936	33	1937	
1885	353	1921	87	1932	60	1933	
	527	1941					
1886	29	1894	500	1921	257	1923	
	41	1930	397	1936	106	1941	
1887	89	1911	220	1922	484	1941	
1888	1,301	1914	34	1931			
1889	117	1937					
1890	72	1896	140	1919	24	1922	
	25	1933	18	1941			
1891	456	1908	136	1910	939	1914	
	150	1918	53	1928	15	1937	
	7,230	1939					
1892	738	1908	20	1924	110	1925	
	160	1928	24	1929	20	1931	
	26	1934	162	1939	30	1940	
1893	272	1906					
1894	4,120	1908	240	1912	583	1916	
	60	1919	265	1924	157	1926	
	26	1927	72	1934	50	1935	
	1,836	1936	55	1937	87	1941	
1895	263	1933	79	1941			
1896	309	1919	23	1928	28	1934	
	80	1939					
1897	25	1910	45	1934	108	1938	
1898	500	1907	2,713	1914	48	1933	
1899	356	1906	340	1910	1,444	1920	
	599	1921					
1900	88	1911					
1902	3,309	1910	830	1914			
1903	563	1906	70	1939			

<i>Year</i>				<i>Feet</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1904	77	1929					
1905	299	1911	271	1913	338	1931	
	281	1932					
1906	341	1940					
1907	1,052	1910	896	1911	317	1922	
	312	1923	222	1928	16	1929	
1908	154	1928	554	1936	268	1940	
1909	356	1910	412	1911	60	1919	
	175	1924	13	1926	176	1927	
	144	1928	59	1933	20	1936	
	240	1940	463	1942			
1910	788	1911	993	1913	153	1925	
	27	1926	37	1928	46	1931	
	84	1935					
1911	117	1912	409	1914	25	1929	
	61	1934	377	1941			
1912	235	1926	46	1928	42	1929	
	96	1939					
1913	80	1925	757	1927	168	1928	
	23	1930	33	1935	351	1939	
	49	1942					
1914	87	1935	72	1939			
1915	797	1924	440	1926	77	1933	
1916	177	1919	136	1922	74	1926	
	44	1934					
1917	1,389	1919	1,313	1921	336	1924	
	506	1936	28	1941			
1918	2,286	1921	1,038	1923	1,554	1925	
	7	1926	692	1939	230	1940	
	2,051	1941					
1919	2,433	1920	870	1921	89	1922	
	681	1926	183	1928	314	1931	
	860	1934	47	1935	44	1936	
	43	1937	1,319	1941			
1920	1,818	1921	160	1923	212	1924	
	147	1926	46	1927	256	1931	
	142	1939	79	1940	65	1941	
1921	16	1921	250	1922	242	1924	
	112	1925	929	1928	91	1931	
	64	1933	134	1934	205	1935	
	39	1936	108	1938	56	1941	

SURVIVAL AND RETIREMENT

8-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd)

Year				Year				Year				Year			
Installed	Feet	Year	Feet	Year	Feet	Year	Feet	Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1922	510	1924	19	1936	38	1938		1926	819	1926	203	1927	1,979	1928	
1923	176	1924	14	1925	12	1926			749	1929	556	1930	157	1936	
	878	1929	86	1930	327	1934			20	1937	11	1938	167	1940	
	11	1941							283	1941					
1924	339	1925	1,025	1926	307	1928		1927	542	1928	15	1929	421	1930	
	181	1929	73	1930	379	1934			54	1932	34	1936	358	1939	
	13	1936	612	1937	150	1939			2,599	1940					
	123	1941						1928	54	1928	44	1929	4	1930	
1925	18	1925	2,585	1926	571	1927			42	1932	8	1937	273	1941	
	45	1929	1,443	1930	1,129	1934		1929	29	1930					
	139	1935	787	1936	36	1938		1930	340	1937	39	1938			
	22	1940	170	1941				1938	6	1938					

10-IN. CAST-IRON UNLINED MAINS

Year				Year			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1854	3,269	3,116	153	1909	4,458	4,250	208
1855	282	282	0	1910	3,233	3,233	0
1859	45	0	45	1911	7,782	7,732	50
1866	4,027	3,877	150	1912	2,335	2,335	0
1867	3,520	3,465	55	1913	1,864	1,797	67
1872	1,982	1,982	0	1914	1,009	1,009	0
1873	1,420	1,420	0	1915	2,420	2,420	0
1874	5,419	5,291	128	1916	3,923	3,923	0
1875	1,813	1,813	0	1917	3,084	3,084	0
1876	2,382	2,284	98	1918	1,051	1,051	0
1877	10,263	0	10,263	1919	2,119	2,119	0
1878	716	534	182	1920	3,562	3,562	0
1879	1,839	1,839	0	1921	14,277	14,277	0
1881	3,606	3,601	5	1922	15,853	14,587	1,266
1882	2,832	412	2,420	1923	5,172	5,172	0
1884	4,133	4,133	0	1924	704	683	21
1886	7,307	7,284	23	1925	703	703	0
1887	10,717	9,742	975	1926	39	39	0
1888	4,195	4,183	12	1927	1,213	1,213	0
1889	3,993	3,480	513	1928	73	73	0
1890	2,543	2,543	0	1929	59	59	0
1891	7,637	7,605	32	1930	278	278	0
1892	7,182	6,959	223	1931	349	349	0
1893	10,121	9,962	159	1933	23	23	0
1894	16,484	16,484	0	1934	7	7	0
1895	7,270	7,261	9	1935	43	43	0
1896	5,408	5,408	0	1936	59	59	0
1897	3,974	3,974	0	1937	89	89	0
1898	8,507	7,322	1,185	1938	56	56	0
1899	924	924	0	1939	44	44	0
1901	2,949	2,569	380	1940	28	28	0
1902	6,194	5,695	499	1941	40	40	0
1903	4,785	4,569	216				
1904	10,124	9,703	421				
1905	21,344	15,986	5,358	SUBTOTAL	292,189	266,590	25,599
1906	5,827	5,827	0	Unknown	15,491	12,838	2,653
1907	12,384	11,901	483				
1908	8,823	8,823	0	TOTAL	307,680	279,428	28,252

10-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years

<i>Year</i>				<i>Year</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1854	153	1941		1893	42	1920	8
1859	45	1896			90	1939	19
1866	150	1893		1895	9	1936	
1867	16	1928	39	1901	380	1928	
1874	128	1941		1902	499	1924	
1876	98	1941		1903	124	1921	92
1877	1,198	1933	3,231	1904	255	1905	64
	992	1936	1934		27	1941	75
1878	182	1928		1905	1,847	1909	715
1881	5	1940			1,364	1920	1,034
1882	1,142	1933	1,278		71	1933	1921
1886	23	1941		1907	207	1916	171
1887	576	1925	399	1909	18	1920	190
1888	12	1933	1936	1911	50	1934	1925
1889	513	1908		1913	67	1940	105
1891	32	1911		1922	1,266	1930	1939
1892	223	1941		1924	21	1941	

12-IN. CAST-IRON UNLINED MAINS

<i>Year</i>				<i>Year</i>			
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1860	203	0	203	1918	16,180	15,774	406
1875	1,985	1,985	0	1919	13,026	12,788	238
1891	1,589	1,589	0	1920	43,562	43,008	554
1892	3,029	2,819	210	1921	10,998	10,456	542
1893	1,915	1,915	0	1922	14,533	14,533	0
1894	6,909	6,522	387	1923	29,805	29,805	0
1895	1,417	1,417	0	1924	142,982	141,365	1,617
1896	1,798	1,767	31	1925	114,112	108,734	5,378
1897	4,566	4,566	0	1926	149,368	145,553	3,815
1898	8,832	8,366	466	1927	134,235	132,869	1,366
1899	105	105	0	1928	30,646	30,568	78
1902	7,580	7,503	77	1929	16,113	15,992	121
1903	7,962	7,962	0	1930	11,027	11,027	0
1904	1,519	1,137	382	1931	14,949	14,949	0
1905	1,389	1,389	0	1932	5,013	5,013	0
1906	9,455	9,253	202	1933	864	864	0
1907	14,648	13,931	717	1934	7,237	7,237	0
1908	17,914	17,397	517	1935	24,646	24,646	0
1909	10,354	10,354	0	1936	14,751	14,639	112
1910	22,417	22,106	311	1937	3,294	3,294	0
1911	35,419	34,337	1,082	1938	7,867	7,867	0
1912	18,431	18,382	49	1939	18,291	18,291	0
1913	14,767	14,565	202	1940	1,806	1,806	0
1914	5,670	5,644	26	1941	33,898	33,898	0
1915	11,676	11,676	0	1942	2,578	2,578	0
1916	17,538	17,289	249				
1917	28,829	27,986	843				
				TOTAL	1,119,697	1,099,516	20,181

SURVIVAL AND RETIREMENT

12-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years

Year				Year			
Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1860	203	1896					
1892	210	1928					
1894	128	1907	259	1923			
1896	31	1934					
1898	46	1908	420	1911			
1902	77	1924					
1904	382	1928					
1906	202	1924					
1907	10	1929	312	1930	359	1931	
1908	102	1922	371	1925	44	1941	
1910	201	1910	110	1936			
1911	981	1929	101	1941			
1912	49	1941					
1913	28	1928	174	1938			
1914	26	1934					
1916	249	1924					

Year				Year			
Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1917	384	1921	459	1937			
1918	37	1921	369	1930			
1919	238	1928					
1920	274	1921	96	1922	26	1925	
	68	1935	90	1937			
1921	279	1921	263	1924			
1924	861	1924	427	1930	246	1936	
	83	1941					
1925	16	1926	78	1930	2,624	1934	
	2,148	1935	116	1936	396	1939	
1926	3,461	1927	130	1928	224	1936	
1927	19	1927	1,281	1930	66	1939	
1928	68	1933	10	1937			
1929	71	1930	50	1936			
1936	112	1936					

16-IN. CAST-IRON UNLINED MAINS

Year				Year			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1854	1,489	1,489	0	1929	6,175	6,079	96
1883	42	42	0	1930	8,846	8,846	0
1890	14,410	14,410	0	1931	3,861	3,861	0
1891	10,691	10,691	0	1935	4,340	4,340	0
1892	6,079	6,079	0	1936	4,685	4,685	0
1893	4,576	4,576	0	1937	7,945	7,945	0
1894	10,048	10,048	0	1938	2,514	2,514	0
1896	36	0	36	1939	2,640	2,640	0
1898	7,732	7,406	326	1940	894	894	0
1902	476	476	0	1941	13,316	13,316	0
1903	1,605	1,605	0	1942	0	0	0
1906	32	32	0				
1907	733	733	0	TOTAL	496,091	483,167	12,924
1908	4,776	4,558	218				
1909	1,806	1,806	0				
1910	9,411	8,712	699				
1911	11,639	11,473	166				
1912	2,344	2,021	323				
1913	9,707	9,010	697				
1914	7,616	6,555	1,061				
1915	212	212	0				
1916	7,709	7,709	0				
1917	13,289	13,289	0				
1918	1,138	959	179				
1919	8,787	8,787	0				
1920	23,896	23,258	638				
1921	21,458	21,190	268				
1922	2,652	2,652	0				
1923	1,462	1,462	0				
1924	21,741	21,741	0				
1925	35,941	31,941	4,000				
1926	91,092	87,537	3,555				
1927	93,661	93,210	451				
1928	12,589	12,378	211				

Retirements by Years							
Year				Year			
Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1896	36	1934					
1898	326	1934					
1908	218	1920					
1910	699	1926					
1911	166	1914					
1912	323	1914					
1913	296	1914	401	1921			
1914	1,061	1920					
1918	179	1921					
1920	304	1928	216	1929	38	1935	
	80	1937					
1921	268	1939					
1925	72	1926	661	1934	3,267	1936	
1926	904	1935	2,645	1936	6	1939	
1927	341	1929	110	1931			
1928	211	1936					
1929	38	1930	58	1937			

18-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1883	103	0	103
1942	0	0	0
TOTAL	103	0	103

Retirements by Years

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1883	103	1941	

20-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1883	61	0	61
1898	287	287	0
1942	0	0	0
TOTAL	348	287	61

Retirements by Years

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1883	61	1941	

24-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1854	4,366	1,609	2,757
1856	3,920	3,816	104
1857	91	0	91
1858	139	0	139
1859	5,508	5,508	0
1860	241	0	241
1862	51	0	51
1863	41	0	41
1866	1,247	1,044	203
1867	2,700	2,700	0
1872	8,534	0	8,534
1873	5,833	3,588	2,245
1875	1,017	0	1,017
1877	1,580	1,580	0
1880	324	0	324
1883	4,876	4,876	0
1884	2,890	2,890	0
1886	3,354	3,354	0
1888	6,860	6,860	0
1890	5,211	4,888	323
1891	18,393	18,336	57
1892	1,875	1,875	0
1893	9,414	9,414	0

24-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1907	230	230	0
1908	2,692	2,692	0
1909	2,052	2,052	0
1910	3,016	2,866	150
1911	2,629	1,400	1,229
1912	5,684	5,684	0
1913	8,358	8,303	55
1914	2,498	1,835	663
1915	7,279	7,252	27
1916	2,654	2,654	0
1917	23,058	22,499	559
1918	6,026	6,026	0
1919	8,884	8,884	0
1920	24,988	24,919	69
1921	25,393	25,393	0
1922	10,420	10,282	138
1923	10,536	10,505	31
1924	16,581	16,227	354
1925	29,418	29,418	0
1926	66,916	66,916	0
1927	25,278	25,162	116
1928	70,189	70,189	0
1929	44,980	44,980	0
1930	40,904	40,904	0
1931	24,300	24,300	0
1932	70	70	0
1933	15	15	0
1934	8	8	0
1935	483	483	0
1937	162	162	0
1939	54	54	0
1940	49	49	0
1941	25,112	25,112	0
1942	0	0	0
TOTAL	579,381	559,863	19,518

Retirements by Years

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1854	1,825	1893	902
1856	104	1896	30
1857	91	1896	
1858	139	1896	
1860	241	1896	
1863	51	1896	
1863	41	1896	
1866	203	1935	
1872	1,912	1883	6,622
1873	2,245	1931	
1875	1,017	1931	
1880	324	1896	
1890	323	1919	
1891	57	1928	

SURVIVAL AND RETIREMENT

24-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year	Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1910	150	1914						
1911	231	1921	198	1922	800	1929		
1913	55	1914						
1914	663	1921						
1915	27	1926						
1917	61	1920	498	1921				
1920	69	1932						
1922	138	1927						
1923	31	1928						
1924	354	1928						
1927	67	1929	49	1940				

30-IN. CAST-IRON UNLINED MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1858	327	0	327					
1875	1,850	1,850	0					
1880	6,918	6,775	143					
1881	2,663	2,608	55					
1882	5,232	5,232	0					
1883	2,645	2,645	0					
1886	8,035	6,736	1,299					
1890	9,844	9,698	146					
1891	7,108	7,085	23					
1896	5,174	5,174	0					
1906	97	97	0					
1913	29	29	0					
1920	23,154	23,154	0					
1921	3,714	3,641	73					
1922	657	657	0					
1923	480	480	0					
1924	147	147	0					
1925	1,652	1,652	0					
1926	858	858	0					
1927	20,799	20,390	409					
1928	12,143	12,143	0					
1929	6,267	6,267	0					
1930	5,296	5,211	85					
1931	5,394	5,394	0					
1933	665	665	0					
1934	5,400	5,400	0					
1938	344	344	0					
1939	31	31	0					
1941	491	491	0					
1942	0	0	0					
TOTAL	137,414	134,854	2,560					

30-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years

Year	Installed	Feet	Year	Feet	Year	Feet
1858	327	1896				
1880	143	1929				
1881	55	1896				
1886	634	1925	665	1933		
1890	146	1924				
1891	23	1931				
1921	73	1927				
1927	409	1938				
1930	85	1933				

36-IN. CAST-IRON UNLINED MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1890	620	614	6					
1891	23	0	23					
1902	6,901	6,901	0					
1906	271	271	0					
1913	1,051	1,051	0					
1915	10,525	10,525	0					
1917	3,243	3,243	0					
1918	585	585	0					
1919	2,145	2,018	127					
1920	4,499	4,499	0					
1921	9,729	9,509	220					
1923	2,157	2,157	0					
1924	121	121	0					
1925	2,857	2,857	0					
1926	11,290	11,290	0					
1927	30,262	30,234	28					
1928	8,907	8,907	0					
1929	33,005	33,005	0					
1930	41,854	41,854	0					
1931	51,451	51,451	0					
1937	775	775	0					
1939	1,167	1,167	0					
1941	1,688	1,688	0					
1942	0	0	0					
TOTAL	225,126	224,722	404					

Retirements by Years

Year	Installed	Feet	Year	Installed	Feet
1890	6	1921			
1891	23	1921			
1919	127	1924			
1921	220	1927			
1927	28	1940			

42-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1875	15,886	15,736	150
1880	650	148	502
1881	27,845	26,869	976
1895	13,956	13,956	0
1901	12,280	12,280	0
1902	1,835	1,835	0
1903	6,052	5,500	552
1904	2,920	2,920	0
1907	7,599	7,599	0
1908	5,365	5,365	0
1909	3,046	3,046	0
1910	2,245	2,245	0
1911	11,114	11,114	0
1912	3,073	3,073	0
1913	1,705	1,705	0
1916	13,094	13,094	0
1917	18,972	18,972	0
1918	157	157	0
1919	737	737	0
1920	13,878	13,878	0
1921	1,027	1,027	0
1922	543	543	0
1923	64	0	64
1925	12	12	0
1926	68	68	0
1927	310	182	128
1929	367	351	16
1930	4,991	4,935	56
1934	1,030	1,030	0
1939	1,054	1,054	0
1940	28	28	0
1941	13,089	13,089	0
1942	0	0	0
TOTAL	184,992	182,548	2,444

Retirements by Years

<i>Year</i>				
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1875	150	1927		
1880	330	1927	172	1934
1881	101	1896	875	1934
1903	552	1922		
1923	64	1926		
1927	128	1940		
1929	16	1933		
1930	56	1933		

48-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1908	3,215	3,215	0
1909	21,831	21,648	183
1910	13,948	13,831	117
1911	5,313	5,313	0
1912	14,707	14,707	0
1913	33,371	33,203	168
1914	9,601	9,601	0
1915	35,642	35,642	0
1916	542	542	0
1917	5,608	5,608	0
1918	17,213	16,237	976
1919	7,703	7,703	0
1920	337	337	0
1921	390	390	0
1923	59	59	0
1924	5,406	5,406	0
1926	42	42	0
1927	734	734	0
1928	870	870	0
1929	744	744	0
1930	10	10	0
1936	121	121	0
1939	48	48	0
1941	1,015	1,015	0
1942	668	668	0
TOTAL	179,138	177,694	1,444

Retirements by Years

<i>Year</i>		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1909	183	1927
1910	117	1936
1913	168	1928
1918	976	1941

8-IN. CAST-IRON UNLINED UNIVERSAL MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1921	7,701	3,320	4,381
1922	714	714	0
1922	714	714	0
1923	2,789	2,662	127
1926	1,593	1,593	0
1927	10,323	10,323	0
1930	6,885	6,816	69
1931	4,748	4,748	0
1932	1,699	1,699	0
1942	0	0	0
TOTAL	36,452	31,875	4,577

8-IN. CAST-IRON UNLINED UNIVERSAL
MAINS (contd.)

<i>Retirements by Years</i>				
<i>Year</i>	<i>Feet</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1921	4,358	1921	23	1941
1923	127	1930		
1930	69	1936		

12-IN. CAST-IRON UNLINED UNIVERSAL MAINS

<i>Feet</i>			
<i>Year</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1921	43,893	42,175	1,718
1922	16,049	15,724	325
1923	5,356	5,356	0
1942	0	0	0
TOTAL	65,298	63,255	2,043

Retirements by Years

<i>Year</i>	<i>Feet</i>					
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1921	985	1922	36	1925	201	1927
	496	1932				
1922	325	1923				

16-IN. CAST-IRON UNLINED UNIVERSAL MAINS

<i>Feet</i>			
<i>Year</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1921	3,282	3,177	105
1922	13,072	13,072	0
1923	5,172	5,172	0
1924	10,193	10,193	0
1942	0	0	0
TOTAL	31,719	31,614	105

Retirements by Years

<i>Year</i>	<i>Feet</i>	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1921	105	1930

8-IN. CAST-IRON CEMENT-LINED MAINS

<i>Feet</i>			
<i>Year</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1941	1,845	1,845	0
1942	0	0	0
TOTAL	1,845	1,845	0

24-IN. CAST-IRON CEMENT-LINED MAINS

<i>Feet</i>			
<i>Year</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1941	495	495	0
1942	0	0	0
TOTAL	495	495	0

12-IN. STEEL, BITUMINOUS LINED AND
COATED MAINS

<i>Feet</i>			
<i>Year</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1920	121	121	0
1921	26,234	16,436	9,798
1922	1,673	1,673	0
1923	36	0	36
1942	0	0	0
TOTAL	28,064	18,230	9,834

Retirements by Years

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1921	17	1924	2,421	1935	1,262	1936
	161	1937	87	1938	596	1939
	5,254	1941				
1923	36	1936				

16-IN. STEEL, BITUMINOUS LINED AND
COATED MAINS

<i>Feet</i>			
<i>Year</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1922	18,426	13,807	4,619
1923	6,759	5,782	977
1924	1,154	1,154	0
1942	0	0	0
TOTAL	26,339	20,743	5,596

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1922	707	1940	3,912	1941
1923	977	1941		

24-IN. STEEL, BITUMINOUS LINED AND
COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1921	2,740	2,740	0
1924	7,542	0	7,542
1937	120	120	0
1942	0	0	0
TOTAL	10,402	2,860	7,542

Retirements by Years

Increase by Year					
Year					
Installed	Feet	Year	Feet	Year	
1924	2,129	1928	5,413	1941	

30-IN. STEEL, BITUMINOUS LINED AND
COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1928	75	75	0
1942	0	0	0
TOTAL	75	75	0

36-IN. STEEL, BITUMINOUS LINED AND
COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1922	4,681	4,681	0
1923	28	28	0
1925	24	24	0
1926	118	118	0
1927	111	111	0
1930	610	610	0
1942	0	0	0
TOTAL	5,572	5,572	0

42-IN. STEEL, BITUMINOUS LINED AND
COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1925	8,298	8,298	0
1927	93	93	0
1928	11,680	11,680	0
1930	391	391	0
1942	0	0	0
TOTAL	20,462	20,462	0

44-IN. STEEL, BITUMINOUS LINED AND
COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1926	20,893	20,893	0
1942	0	0	0
TOTAL	20,893	20,893	0

48-IN. STEEL, BITUMINOUS LINED AND
COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1920	22,701	22,701	0
1921	31,895	31,713	182
1922	165	165	0
1925	8,092	8,092	0
1926	2,143	2,135	8
1927	505	505	0
1929	7,783	7,783	0
1930	15,098	15,098	0
1942	0	0	0
TOTAL	88,382	88,192	190

Retirements by Years

Year	Feet	Year
Installed		
1921	182	1927
1926	8	1926

50-IN. STEEL, BITUMINOUS LINED AND
COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1927	2,633	2,633	0
1942	0	0	0
TOTAL	2,633	2,633	0

54-IN. STEEL, BITUMINOUS LINED AND
COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1927	148	148	0
1928	300	300	0
1929	146	146	0
1942	0	0	0
TOTAL	594	594	0

SURVIVAL AND RETIREMENT

60-IN. STEEL, BITUMINOUS LINED AND
COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	24,712	24,712	0
1927	884	884	0
1929	9,237	9,237	0
1930	210	210	0
1931	1,394	1,394	0
1942	0	0	0
TOTAL	36,437	36,437	0

66-IN. STEEL, BITUMINOUS LINED AND
COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	298	298	0
1931	7,256	7,256	0
1942	0	0	0
TOTAL	7,554	7,554	0

72-IN. STEEL, BITUMINOUS LINED AND
COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	500	500	0
1929	30	30	0
1930	27,850	27,850	0
1932	2,866	2,866	0
1939	3,211	3,211	0
1942	0	0	0
TOTAL	34,457	34,457	0

36-IN. TONCAN IRON, BITUMINOUS LINED
AND COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	4,688	4,688	0
1942	0	0	0
TOTAL	4,688	4,688	0

42-IN. ARMCO IRON, BITUMINOUS LINED
AND COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1932	1,072	1,072	0
1942	0	0	0
TOTAL	1,072	1,072	0

54-IN. ARMCO IRON, BITUMINOUS LINED
AND COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1929	9,304	9,304	0
1930	7,078	7,078	0
1931	1,314	1,314	0
1942	0	0	0
TOTAL	17,696	17,696	0

66-IN. ARMCO IRON, BITUMINOUS LINED
AND COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	14,548	14,548	0
1942	0	0	0
TOTAL	14,548	14,548	0

8-IN. CEMENT-ASBESTOS MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1937	1,003	1,003	0
1941	602	602	0
1942	0	0	0
TOTAL	1,605	1,605	0

Huntington, West Virginia

As of December 31, 1940

THE Huntington Water Corporation is a privately-owned company serving the city of Huntington, W.Va., and certain outlying territory, including the town of Barboursville. It also operates under contract and furnishes water to the Lawrence County Water Company, a subsidiary supplying the village of Chesapeake, Ohio, on the opposite bank of the Ohio River. The city of Huntington had a population of 78,836 in 1940 but the population served was about 84,000.

Huntington is located on the south bank of the Ohio River near the extreme western end of the state near the Kentucky line. The city was incorporated in 1871 and is an important commercial and industrial center. It lies on a broad level plain along the river and extends up into the hills beyond. In the late 1930's a flood wall was constructed which has relieved the city of the devastating effects of the periodic high waters of the Ohio to which it was formerly subjected.

As of Dec. 31, 1941, there were 18,957 consumers, 99.5 per cent of whom were served through meter measurement. There were 205 mi. of mains and the average daily pumpage was about 6 mil.gal., equivalent to 76 gpd. per capita. About 21.5 per cent of the water pumped was for industrial use.

Development of the Existing System

On Nov. 22, 1886, the city of Huntington granted a franchise to W. S. Kuhn and his associates in the American Water and Guarantee Company to construct, maintain and operate a water works to supply water to the city of Huntington and its inhabitants. This franchise was assigned to the Huntington Water Corporation, which was incorporated in December 1886.

Work on the construction of the plant was started immediately thereafter, and the water works was put in operation the latter part of 1887. The original plant consisted of a pumping station, 7 mi. of mains and a reservoir located on the distribution system.

In August 1885 the town of Central City passed an ordinance authorizing the same individuals to construct, maintain and operate a water works to supply that town. The franchise was assigned to the Huntington Water Corporation which constructed the distribution system.

In 1888 the town of Guyandotte passed an ordinance granting to the same individuals a franchise to construct and operate a water works to supply the town of Guyandotte. A distribution system was constructed and put into operation in July 1888.

The original system in Guyandotte consisted of about 8,000 ft. of pipeline within the town limits and the original system in Central City consisted of over 3 mi. of pipeline within the limits of that town. Both Guyandotte and Central City secured their water supply from Huntington.

The town of Guyandotte became part of the city of Huntington on Apr. 11, 1911, and the town of Central City was included in Huntington by charter of the latter city in 1909.

The Huntington Water Corporation was incorporated in 1917 and the franchise of the Huntington Water Corporation and the Guyandotte Water Company were assigned to it, together with the rights to serve all of their respective territories.

In February 1929 the Huntington Water Corporation acquired all the property and business and franchise rights of the Barboursville Water and Light Company, supplying water service to the city of Barboursville located about 5 mi. east of Huntington. The Barboursville system was connected to the Huntington system by a pipeline extension of some 18,000 ft. of 8-in. cast-iron cement-lined pipe.

The territory, as now comprised, is about 12 mi. long and has a varying width with a maximum of 3 mi.

The American Water Works and Guarantee Company was a predecessor company of and became the American Water Works and Electric Company, Inc., in 1914. Since its original construction, therefore, the system, with the exception of the Barboursville and several minor areas, has been under one continuous ownership and management.

The original pump station of the Huntington Water Corporation was located on the bank of the Ohio River some twenty blocks east of the center

of town. It consisted of a pump pit in which were located two 0.5-mil.gal. direct-acting steam pumps with suction lines extending into the Ohio River. Water was pumped by these pumps through pressure filters directly into the distribution system, which consisted of 7 mi. of pipe, as provided for in the original ordinance, with a 2.5-mil.gal. reservoir located on a high spot on a hill at the edge of the distribution system. A part of the original pump station and the reservoir are still in service. The elevation of the pump pit floor is 506 and the elevation of the reservoir overflow is 821.

It was soon demonstrated that the pressure filter system was a failure, as the untreated turbid water taken from the Ohio River quickly blocked the sand in the filters. The filter plant was abandoned and the water company, in an effort to supply its consumers with potable water, constructed a submerged crib in the bed of the river. This method was successful only a relatively short time, as the crib became clogged with fine sand and silt deposits. The company next installed a system of Cook wells in the sand bar in front of the pump station. This method of furnishing a clear water supply proved partly successful, but with continued use of the wells the yield decreased as the surface of the sand bed in which the wells were located gradually became clogged with silt and fine sand deposited by the river water.

For the last several years during which the well system constituted the principal source of supply, it became necessary more and more frequently to use untreated river water. This trouble continued until a gravity rapid sand filter plant, as well as a settling tank and necessary equipment for introducing coagulant into the water, was installed in 1899. At this time also, the

TABLE 1
SUMMARY OF MAINS
HUNTINGTON, WEST VIRGINIA

Size, <i>in.</i>	Kind	No. of Feet Installed	No. of Feet Identified	Per- cent- age of Total	No. of Feet Re- tired	Per- cent- age of Total	No. of Feet in Service	Per- cent- age of Total	Year of First Instal- lation	Aver- age Age, <i>yr.</i>
4	Cast-iron unlined	12,643	12,643	1.2	0	0.0	12,643	1.3	1887	52.4
6		168,809	168,809	16.7	119	0.1	168,690	17.6	1887	34.3
8		126,219	126,219	12.0	144	0.2	126,075	13.2	1887	26.5
10		31,996	31,996	3.0	0	0.0	31,996	3.3	1887	39.3
12		58,607	58,607	5.6	199	0.2	58,408	6.1	1887	29.1
16		9,768	9,768	0.9	0	0.0	9,768	1.2	1906	24.7
20		4,469	4,469	0.4	0	0.0	4,469	0.5	1921	19.5
2	Cast-iron cement-lined	58,756	58,756	5.6	799	0.8	57,957	6.1	1929	3.5
6		4,764	4,764	0.4	0	0.0	4,764	0.5	1926	7.6
8		94,837	94,837	9.0	0	0.0	94,837	9.9	1925	11.1
12		30,071	30,071	2.9	0	0.0	30,071	3.1	1926	12.9
16		6,355	6,355	0.6	0	0.0	6,355	0.7	1927	13.5
20		2,796	2,796	0.3	0	0.0	2,796	0.3	1930	10.5
$\frac{1}{2}$		470	470	0.0	0	0.0	470	0.0	1920	20.5
$\frac{3}{4}$	Galvanized steel	5,607	5,607	0.5	0	0.0	5,607	0.6	1920	6.9
1		15,762	15,670	1.4	4,304	4.6	11,366	1.2	1911	20.5
1 $\frac{1}{4}$		6,376	6,376	0.6	0	0.0	6,376	0.7	1911	20.6
1 $\frac{1}{2}$		4,109	4,109	0.4	355	0.4	3,754	0.4	1911	20.9
2		259,542	251,160	23.9	32,985	35.2	218,175	22.8	1911	19.4
2 $\frac{1}{2}$		185	185	0.0	0	0.0	185	0.0	1911	29.5
3		1,376	1,376	0.1	235	0.3	1,141	0.1	1911	14.1
4	Galvanized wrought-iron	2,064	2,064	0.2	0	0.0	2,064	0.2	1920	18.5
12		444	444	0.0	0	0.0	444	0.0	1923	17.5
$\frac{3}{4}$		367	246	0.0	246	0.3	0	0.0	1888	—
1		2,566	2,310	0.2	2,082	2.2	228	0.0	1887	34.0
1 $\frac{1}{4}$		396	396	0.0	195	0.2	201	0.0	1888	29.5
1 $\frac{1}{2}$		3,355	3,166	0.3	2,796	3.0	370	0.0	1887	43.2
2		150,289	142,768	13.5	47,877	51.2	94,891	9.9	1887	31.8
2 $\frac{1}{2}$	Black wrought- iron	185	185	0.0	0	0.0	185	0.0	1911	29.5
3		1,273	1,273	0.1	1,213	1.3	60	0.0	1904	29.5
1 $\frac{1}{4}$		160	160	0.0	0	0.0	160	0.0	1926	14.5
2	Black wrought- iron	1,676	1,676	0.2	0	0.0	1,676	0.2	1926	14.5
1	Lead	418	418	0.0	0	0.0	418	0.0	1920	18.6
8	Talbot unwrapped	486	486	0.0	0	0.0	486	0.1	1930	10.5
TOTAL		1,067,196	1,050,635	100.0	93,549	100.0	957,086	100.0		23.8
Percentage of Total			100.00		8.90		91.10			
Average Size, <i>in.</i>			5.35		1.95		5.68			

TABLE 1 (contd.)
Mortality Survival Ratios

Size, in.	Kind	No of Feet	Period Covered, yr	Percentage
$\frac{1}{2}$ -1 $\frac{1}{2}$	All	38,928	52.5	11.106
4	Cast-iron unlined	12,643	53.5	54.293
6		168,809	53.5	100.000
8		126,219	53.5	99.837
10 and 12		90,603	53.5	99.803
Over 12		14,237	34.5	100.000
2	Cast-iron cement-lined	58,756	11.5	96.517
6 to 20	Cast-iron cement-lined	138,823	15.5	100.000
12	Galvanized steel	444	17.5	100.000
2 to 4	Wrought-iron and galvanized steel	400,687	52.5	54.293
8	Talbot unwrapped	486	10.5	100.000
TOTAL		1,050,635		

original suction lines were replaced with new and larger suction lines extending to mid-channel. This prevented sand bars from forming and covering the strainers. The filter plant proved successful in operation from the start and the city of Huntington and the other communities served have been furnished with filtered water since 1899.

The filter plant was added to from time to time as the increase in water consumption required, and in 1930 the original four wooden filter tubs were replaced. The filter plant has increased in capacity from the original 2-mgd. capacity in 1899 to a nominal 9-mgd. capacity at the present time.

The sedimentation facilities originally installed as part of the purification system consisted of small wooden tanks. These were later replaced by two large steel tanks, and later a concrete basin of 1-mil.gal. capacity was installed. The original steel settling tanks are now used as pre-sedimentation and grit chamber tanks.

In 1923, because of pollution entering the Ohio River from sewerage outfalls discharging into the Guyan River

(which originally marked the boundary line between Huntington and Guyandotte), it became advisable to move the intake facilities to a point on the Ohio River about 3 mi. above the original station at 24th Street.

There was constructed on the bank of the river an intake chamber of reinforced concrete, 33 ft. \times 26 ft. \times 78 $\frac{1}{2}$ ft. high. The interior is divided into a pump room and a wet chamber. The wet chamber is divided into two sections by a reinforced concrete wall and equipped with box screens over the pump suction. The top of the pit extends well above record high water. From this point a 24-in. cast-iron pipeline was laid to the main station called the 24th Street Station.

The pumping equipment at the new station, known as the Guyandotte Low Service Station, consists of vertical motor-driven centrifugal pumps which delivered the water through the 24-in. line to the 24th Street Station, discharging into the steel tanks from which the water flows by gravity to the concrete sedimentation basin and thence to the filters. From the filters it goes

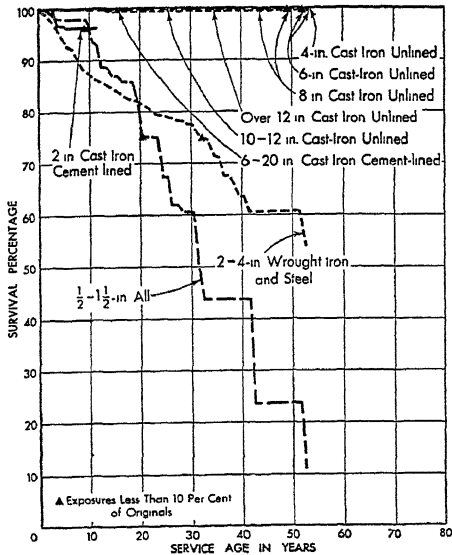


FIG. 1. Mortality Survival Curve— $\frac{1}{2}$ -20-in. Mains—Huntington, West Virginia

BASE: Feet		SURVIVAL: 1887-1940	
SIZE	KIND	EXPOSURES	RETIREMENTS
in.		ft.	ft.
$\frac{1}{2}$ -1 $\frac{1}{2}$	All	38,928	9,978
2-4	Wrought-Iron and Steel	400,687	82,310
2	Cast-Iron Cement-Lined	58,756	799
6-20		138,823	0
4		12,643	0
6	Cast-Iron Unlined	168,809	119
8		126,219	144
10-12		90,603	199
Over 12		14,237	0

to a clear well and is pumped directly into the distribution system.

In this same year the original pump station and filter buildings at the 24th Street Station were replaced or veneered with new tapestry brick buildings and greatly enlarged, and at the same time, four 1-mgd. rapid sand concrete filters were added.

As the city grew there was extensive development on the hills to the south

of town and elevations to be served from the general service necessitated the installation of two booster stations with elevated storage tanks.

Basis of Study

The installations and retirements of pipe were compiled from a study made for the purpose of listing all pipe that had been retired over the life of the property. The study was made coincidentally with an inventory of existing mains. Company records were substantially complete as to size, kind and date of installation over the entire plant life. Existing retirement records were checked and supplemented by checking pipe installed with the pipe existing in specific locations.

Mortality Survival Study

Mortality studies of mains only were made. Table 1 is a summary of the pertinent information relative to the pipe systems. Figure 1 shows the mortality survival curves covering the amount, types and sizes of pipe grouped as shown.

A brief summary of Class B facilities covering wells, purification plant, pumping facilities and distribution reservoirs, tanks and standpipes is given below.

Causes of Retirement

There is no satisfactory record from which could be determined the causes of the retirement of mains.

Acknowledgment

The collection and compilation of data pertaining to the Huntington Water Corporation were carried out by the personnel of the American Water Works and Electric Company, Inc.

SUMMARY OF CLASS B FACILITIES
HUNTINGTON, WEST VIRGINIA

Wells

Barboursville Wells

No. 1—Drilled 8-in. well, 63 ft. deep; steel cased, 8-in. strainer, 10 ft. long, pumped by plunger pump. Constructed in 1925 and still in service.

No. 2—Same as No. 1 except 59 ft. deep.

No. 3—Same as No. 1 except 55 ft. deep. Constructed in 1928 and still in service.

No. 4—Dug well, 3 ft. 6 in. square, 55 ft. deep; 15-in. diameter perforated steel casing, surrounded by gravel, pumped by centrifugal well pump. Constructed in 1928 and still in service.

Purification Works

Settling Tank—Wood tank, 30-ft. diameter by 16 ft. high; 85,000-gal. capacity. Constructed in 1898 and retired in 1913.

Settling Basin—Concrete basin, 85 ft. wide, 94.5 ft. long, 16 ft. deep; 900,000-gal. capacity. Constructed in 1922 and still in service.

Sedimentation Tank No. 1—Open steel riveted tank, 50-ft. diameter by 20 ft. high; 300,000-gal. capacity. Erected in 1904 and still in service.

Sedimentation Tank No. 2—Open steel riveted tank, 50-ft. diameter, 27.5 ft. high; 400,000-gal. capacity. Erected in 1913, top 4 ft. added in 1922, and still in service.

Original Filters—Four wood tub filters, 15-ft. diameter by 8 ft. high; 0.5-mgd. capacity each. Installed in 1899 and replaced in 1930 by steel tubs.

Steel Tub Filters—Ten steel tubs, 15-ft. diameter by 8 ft. high; 0.5-mgd. capacity each. First two installed in 1901, second two in 1906, third two in 1921 and last four in 1930; strainers in 1901 and 1906; tubs replaced in 1935; and still in service.

Concrete Filters—Four reinforced concrete, rapid sand, gravity filters, rated 1.0-mgd. capacity each. Constructed in 1923 and still in service.

Clear Water Basin—Rubble stone and concrete under filter house, 150,000-gal. capacity. Constructed in 1898 and still in service.

Pumping Equipment

24th Street Station

Low-Service No. 1—Hall direct-acting, vertical, compound, duplex, steam pump; 2.5-

mgd. capacity, 85-ft. head. Installed in 1894 and still in service.

Low-Service No. 2—Worthington direct-acting, vertical, compound, duplex steam pump; 2.5-mgd. capacity, 104-ft. head. Installed in 1900 and still in service.

Low-Service No. 3—Worthington direct-acting, vertical, triple expansion, duplex, condensing steam pump; 5.0-mgd. capacity, 92.5-ft. head. Installed in 1906 and still in service.

No. 1—Worthington direct-acting, compound, non-condensing steam pump; rated 1.0-mgd. capacity. Installed in 1887 and retired in 1891.

No. 2—Worthington direct-acting, duplex, non-condensing steam pump; rated 1.5-mgd. capacity. Installed in 1887 and retired in 1900.

No. 3—Gordon direct-acting duplex steam pump; rated 2-mgd. capacity, 335-ft. head. Installed in 1892 and retired in 1894.

No. 4—Gordon direct-acting compound steam pump; rated 2-mgd. capacity. Installed in 1894 and retired in 1930.

High-Service No. 5—Worthington direct-acting, horizontal, compound, duplex, condensing steam pump; 2.5-mgd. capacity, 335-ft. head. Installed in 1898 and still in place but not used since 1939.

High-Service No. 6—Wood direct-acting, horizontal, triple expansion, duplex, condensing steam pump; 5.0-mgd. capacity, 300-ft. head. Installed in 1905 and still in service.

High-Service No. 7—LeCourtenay two single-stages in series, volute centrifugal pump driven through reduction gear by 346-hp. Terry steam turbine; rated 5.0-mgd. capacity at 315-ft. head. Installed in 1922 and still in service.

High-Service No. 8—Worthington two single-stages in series, volute centrifugal pump driven by 500-hp. synchronous motor; rated 7.0-mgd. capacity at 300-ft. head. Installed in 1931 and still in service.

Guyandotte Station

Low Service No. 1—Worthington single-stage centrifugal pump; rated 6.0-mgd. capacity at 103-ft. head, driven by 150-hp. induction motor. Installed in 1923 and still in service.

Low-Service No. 2—Same as No. 1 except rated 5.0-mgd. capacity at 94.5-ft. head.

Low-Service No. 3—DeLaval single-stage centrifugal pump; rated 8.0-mgd. capacity at

SUMMARY OF CLASS B FACILITIES (contd.)

35-ft. head, driven by 100-hp. synchronous motor. Installed in 1930 and still in service.

Barboursville Station

Well No. 1—Fairbanks Morse centrifugal pump installed in 1917, and Cook vertical plunger pump installed in 1925; belt driven by 50-hp. Bessemer gas engine. Installed in 1917 and still in service.

Well No. 2—Cook vertical plunger pump belt driven by above engine. Installed in 1925 and still in service.

Well No. 3—Same as above except installed in 1928.

Well No. 4—Peerless deep well pump, rated 400-gpm. capacity at 60-ft. head, driven by 10-hp. motor. Installed in 1928 and still in service.

High-Service—Dayton-Dowd two-stage centrifugal pump; rated 200-gpm. capacity at 180-ft. head, driven by 20-hp. motor. Installed in 1917 and still in service.

Ritter Hill Booster Station

No. 1—American Marsh four-stage centrifugal pump; rated 100-gpm. capacity at 276-ft. head, driven by 25-hp. induction motor. Installed in 1925 and still in service.

No. 2—Worthington two-stage centrifugal pump; rated 400-gpm. capacity at 276-ft.

head, driven by 60-hp. induction motor. Installed in 1925 and still in service.

Roland Park Booster Station

Advance three-stage centrifugal pump; rated 100-gpm. capacity at 300-ft. head, driven by 25-hp. induction motor. Installed in 1925 and retired in 1935 and replaced by Goulds two-stage, 1-in. pump driven by 3-hp. motor, still in service.

Reservoirs, Tanks and Standpipes

Walnut Hill Reservoir—Open, earth embankment reservoir, bottom concrete paved, slopes lined with concrete and riprap; 140 ft. wide by 320 ft. long, 20 ft. deep; 2.5-mil.gal. capacity. Constructed in 1888 and still in service.

Shockey's Knob Standpipe—Covered steel standpipe, 16-ft. diameter, 60 ft. high; 100,000-gal. capacity. Erected in 1923 and still in service.

Roland Park Elevated Tank—Covered wood tank, 14-ft. diameter, 14 ft. high; 15,000-gal. capacity on 50-ft. steel tower. Erected in 1922 and still in service.

Barboursville Standpipe—Open steel standpipe, 42-ft. diameter, 19.5 ft. high; 200,000-gal. capacity. Erected in 1926 and still in service.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
HUNTINGTON, WEST VIRGINIA

MAINS

4-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1887	4,153	4,153	0
1888	6,953	6,953	0
1889	550	550	0
1891	918	918	0
1916	69	69	0
1940	0	0	0
TOTAL	12,643	12,643	0

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1887	14,063	14,063	0
1888	6,017	6,017	0
1889	250	250	0
1891	5,460	5,460	0
1892	4,464	4,464	0
1894	2,046	2,046	0
1895	6,134	6,118	16
1896	433	433	0
1898	1,871	1,871	0
1899	1,028	1,028	0
1900	2,893	2,893	0
1901	404	404	0
1902	2,098	2,098	0
1903	3,352	3,352	0
1904	2,962	2,962	0
1905	16,881	16,869	12
1906	10,867	10,867	0
1907	20,666	20,644	22
1908	3,999	3,999	0
1909	4,428	4,428	0
1911	8,187	8,118	69
1912	4,942	4,942	0
1913	1,561	1,561	0
1914	2,941	2,941	0
1915	2,237	2,237	0
1916	5,320	5,320	0
1917	1,842	1,842	0
1918	2,703	2,703	0
1919	389	389	0
1920	2,121	2,121	0
1921	2,954	2,954	0
1922	14,085	14,085	0
1923	2,264	2,264	0
1924	6,038	6,038	0

6-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	909	909	0
1940	0	0	0
TOTAL	168,809	168,690	119

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>		
1895	16	1939
1905	12	1940
1907	22	1937
1911	69	1933

8-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1887	5,933	5,933	0
1888	3,953	3,953	0
1891	4,175	4,175	0
1894	5,155	5,155	0
1902	1,906	1,834	72
1904	4,905	4,905	0
1905	2,717	2,717	0
1906	4,175	4,175	0
1907	2,513	2,513	0
1908	2,523	2,523	0
1910	5	5	0
1911	1,414	1,414	0
1912	9,034	9,034	0
1914	1,248	1,248	0
1915	230	230	0
1916	1,378	1,378	0
1917	8,437	8,437	0
1918	4,321	4,321	0
1920	747	747	0
1921	3,911	3,911	0
1922	4,785	4,785	0
1923	14,168	14,168	0
1924	23,903	23,903	0
1925	11,144	11,144	0
1926	836	764	72
1928	2,703	2,703	0
1940	0	0	0
TOTAL	126,219	126,075	144

8-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Retirements by Years</i>			
<i>Year</i>	<i>Feet</i>		<i>Year</i>
<i>Installed</i>			
1902	72		1926
1926	72		1937

10-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1887	10,050	10,050	0
1894	3,457	3,457	0
1898	2,970	2,970	0
1910	485	485	0
1911	7,460	7,460	0
1912	3,037	3,037	0
1914	2,994	2,994	0
1918	820	820	0
1922	315	315	0
1923	408	408	0
1940	0	0	0
TOTAL	31,996	31,996	0

12-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1887	5,087	5,087	0
1898	9,081	9,081	0
1904	525	525	0
1911	6,662	6,662	0
1912	12,671	12,671	0
1914	1,463	1,431	32
1917	3,520	3,520	0
1919	522	522	0
1921	2,088	2,088	0
1922	3,849	3,775	74
1923	9,818	9,818	0
1924	1,721	1,721	0
1925	873	780	93
1926	727	727	0
1940	0	0	0
TOTAL	58,607	58,408	199

Retirements by Years

<i>Year</i>	<i>Feet</i>		<i>Year</i>
<i>Installed</i>			
1914	32		1937
1922	74		1938
1925	93		1937

16-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1906	1,749	1,749	0
1912	3,646	3,646	0
1921	473	473	0
1923	3,900	3,900	0
1940	0	0	0
TOTAL	9,768	9,768	0

20-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1921	4,469	4,469	0
1940	0	0	0
TOTAL	4,469	4,469	0

2-IN. CAST-IRON CEMENT-LINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1929	876	876	0
1930	2,551	2,551	0
1931	3,685	3,685	0
1932	1,285	1,285	0
1933	720	720	0
1934	364	364	0
1935	2,247	2,217	30
1936	5,131	5,131	0
1937	6,912	6,143	769
1938	12,238	12,238	0
1939	13,484	13,484	0
1940	9,263	9,263	0
TOTAL	58,756	57,957	799

Retirements by Years

<i>Year</i>	<i>Feet</i>		<i>Year</i>
<i>Installed</i>			
1935	30		1940
1937	769		1940

6-IN. CAST-IRON CEMENT-LINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	1,292	1,292	0
1927	192	192	0
1928	876	876	0
1933	108	108	0

SURVIVAL AND RETIREMENT

6-IN. CAST-IRON CEMENT-LINED MAINS
(contd.)

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1934	144	144	0
1937	310	310	0
1939	16	16	0
1940	1,826	1,826	0
TOTAL	4,764	4,764	0

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	6,276	6,276	0
1926	28,992	28,992	0
1927	8,520	8,520	0
1928	8,301	8,301	0
1929	6,144	6,144	0
1930	8,760	8,760	0
1831	5,232	5,232	0
1932	7,464	7,464	0
1833	1,475	1,475	0
1934	24	24	0
1937	1,173	1,173	0
1938	9,411	9,411	0
1939	1,020	1,020	0
1940	2,045	2,045	0
TOTAL	94,837	94,837	0

12-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	11,424	11,424	0
1927	7,824	7,824	0
1928	7,608	7,608	0
1929	1,512	1,512	0
1937	658	658	0
1938	1,045	1,045	0
1940	0	0	0
TOTAL	30,071	30,071	0

16-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	6,336	6,336	0
1930	19	19	0
1940	0	0	0
TOTAL	6,355	6,355	0

20-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	2,796	2,796	0
1940	0	0	0
TOTAL	2,796	2,796	0

½-IN. GALVANIZED STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1920	470	470	0
1940	0	0	0
TOTAL	470	470	0

¾-IN. GALVANIZED STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1920	800	800	0
1926	50	50	0
1929	54	54	0
1934	193	193	0
1935	2,618	2,618	0
1936	661	661	0
1937	123	123	0
1938	459	459	0
1939	649	649	0
1940	0	0	0
TOTAL	5,607	5,607	0

1-IN. GALVANIZED STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1911	125	125	0
1915	1,117	0	1,117
1917	62	62	0
1920	14,205	11,018	3,187
1927	161	161	0
1940	0	0	0
SUBTOTAL	15,670	11,366	4,304
Unknown	92	0	92
TOTAL	15,762	11,366	4,396

Retirements by Years

Year	Feet		Year	Feet	
<i>Installed</i>	<i>Feet</i>		<i>Year</i>	<i>Feet</i>	
1915	1,117		1927		
1920	1,133		1939	2,054	1940

1½-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1911	201	201	0
1920	5,960	5,960	0
1926	215	215	0
1940	0	0	0
TOTAL	6,376	6,376	0

1½-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1911	150	150	0
1920	3,959	3,604	355
1940	0	0	0
TOTAL	4,109	3,754	355

Retirements by Years

Year	Feet	Year
Installed		
1920	355	1940

2-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1911	2,541	2,241	300
1914	34,687	26,357	8,330
1915	13,670	10,489	3,181
1916	9,603	7,499	2,104
1917	9,122	4,812	4,310
1918	1,776	1,205	571
1919	7,827	6,048	1,779
1920	39,877	38,451	1,426
1921	24,151	20,071	4,080
1922	14,655	13,325	1,330
1923	22,419	19,824	2,595
1924	8,838	8,453	385
1925	19,461	19,292	169
1926	19,627	19,627	0
1927	6,197	6,197	0
1928	12,583	10,435	2,148
1929	277	0	277
1930	1,099	1,099	0
1931	22	22	0
1932	252	252	0
1933	1,495	1,495	0
1934	981	981	0
1940	0	0	0
SUBTOTAL	251,160	218,175	32,985
Unknown	8,382	0	8,382
TOTAL	259,542	218,175	41,367

2-IN. GALVANIZED STEEL MAINS (contd.)

Retirements by Years						
Year	Installed	Feet	Year	Feet	Year	Feet
1911	179	1936	79	1937	42	1938
1914	51	1914	50	1916	338	1917
	1,270	1918	830	1921	2,931	1922
	1,235	1923	1,116	1924	222	1926
	287	1927				
1915	277	1917	814	1921	703	1922
	897	1923	150	1925	340	1927
1916	1,170	1921	163	1922	330	1924
	441	1927				
1917	1,417	1921	1,685	1922	723	1923
	342	1927	143	1931	356	1919
	215	1924				
1918	356	1919	215	1924		
1919	870	1923	273	1926	560	1927
	76	1937				
1920	197	1922	426	1923	642	1924
	161	1927				
1921	218	1922	990	1924	266	1925
	201	1926	1,406	1930	187	1937
	812	1940				
1922	1,098	1924	37	1926	195	1936
1923	791	1924	668	1925	157	1927
	122	1936	857	1940		
1924	385	1927				
1925	155	1937	14	1939		
1928	483	1933	1,665	1938		
1929	277	1940				

2½-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1911	185	185	0
1940	0	0	0
TOTAL	185	185	0

3-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1911	235	0	235
1924	686	686	0
1930	455	455	0
1940	0	0	0
TOTAL	1,376	1,141	235

Retirements by Years

Year	Feet	Year
Installed		
1911	235	1940

4-IN. GALVANIZED STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1920	1,860	1,860	0
1940	204	204	0
TOTAL	2,064	2,064	0

12-IN. GALVANIZED STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1923	444	444	0
1940	0	0	0
TOTAL	444	444	0

 $\frac{3}{4}$ -IN. GALVANIZED WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1888	246	0	246
1940	0	0	0
SUBTOTAL	246	0	0
Unknown	121	0	121
TOTAL	367	0	367

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1888	246	1940

1-IN. GALVANIZED WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1887	106	0	106
1888	253	0	253
1891	283	0	283
1898	806	0	806
1899	48	0	48
1901	308	103	205
1902	341	0	341
1911	165	125	40
1940	0	0	0
SUBTOTAL	2,310	228	2,082
Unknown	256	0	256
TOTAL	2,566	228	2,338

1-IN. GALVANIZED WROUGHT-IRON MAINS
(contd.)

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year
<i>Installed</i>						
1887	106	1898				
1888	253	1898				
1891	283	1903				
1898	345	1900	250	1909	211	1924
1899	48	1927				
1901	205	1925				
1902	232	1912	109	1916		
1911	40	1930				

 $1\frac{1}{4}$ -IN. GALVANIZED WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1888	195	0	195
1911	201	201	0
1940	0	0	0
TOTAL	396	201	195

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1888	195	1898

 $1\frac{1}{2}$ -IN. GALVANIZED WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1887	20	0	20
1888	2,304	220	2,084
1889	417	0	417
1900	275	0	275
1911	150	150	0
1940	0	0	0
SUBTOTAL	2,166	370	2,796
Unknown	189	0	189
TOTAL	3,355	370	2,985

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year
<i>Installed</i>						
1887	20	1898				
1888	326	1891	797	1898	377	1904
	82	1912	100	1919	402	1930
1889	417	1903				
1900	135	1931	140	1932		

2-IN. GALVANIZED WROUGHT-IRON MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1887	575	0	575
1888	5,085	2,217	2,868
1889	820	0	820
1891	1,988	50	1,938
1892	2,989	1,419	1,570
1894	296	0	296
1895	541	253	288
1896	2,470	220	2,250
1898	1,312	428	884
1899	745	421	324
1900	3,097	2,474	623
1901	2,326	1,271	1,055
1902	4,787	3,765	1,022
1903	4,887	3,158	1,729
1904	7,678	5,526	2,152
1905	5,137	4,300	837
1906	4,293	1,928	2,365
1907	9,696	6,228	3,468
1908	5,761	3,494	2,267
1909	4,809	2,440	2,369
1910	9,668	4,556	5,112
1911	20,543	16,107	4,436
1912	8,136	7,371	765
1913	22,817	17,749	5,068
1916	7,499	5,272	2,227
1917	4,813	4,244	569
1940	0	0	0
<hr/>			
SUBTOTAL	142,768	94,891	47,877
Unknown	7,521	0	7,521
<hr/>			
TOTAL	150,289	94,891	55,398

Retirements by Years

<i>Year</i>	<i>Feet</i>		<i>Year</i>		<i>Feet</i>	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1887	575	1898				
1888	1,372	1891	300	1901	134	1903
	440	1910	372	1922	250	1940
1889	820	1912				
1891	412	1906	265	1907	265	1908
	220	1925	450	1927	326	1930
1892	528	1905	1,042	1923		
1894	70	1902	226	1930		
1895	288	1936				
1896	512	1900	410	1911	444	1912
	524	1932	360	1934		
1898	632	1905	252	1912		
1899	324	1906				
1900	323	1906	300	1911		
1901	321	1906	368	1922	366	1923
1902	65	1904	270	1907	396	1910
	91	1912	200	1937		

2-IN. GALVANIZED WROUGHT-IRON MAINS (contd.)

Retirements by Years (contd.)						
Year						
Installed	Feet	Year	Feet	Year	Feet	Year
1903	673	1905	359	1906	28	1911
	200	1912	120	1924	349	1927
1904	934	1905	620	1924	146	1936
	452	1937				
1905	367	1905	259	1906	211	1922
1906	430	1907	206	1911	185	1915
	409	1922	250	1925	258	1931
	227	1937	400	1940		
1907	172	1907	378	1908	802	1911
	352	1912	429	1918	128	1921
	258	1922	668	1924	245	1934
	36	1940				
1908	225	1911	425	1912	480	1916
	912	1921	225	1923		
1909	400	1911	739	1912	444	1917
	456	1923	250	1924	80	1938
1910	1,025	1912	1,792	1917	428	1918
	355	1921	282	1922	140	1924
	345	1927	360	1928	210	1935
	175	1937				
1911	225	1917	1,473	1918	795	1923
	167	1924	1,210	1926	180	1927
	86	1930	300	1932		
1912	182	1917	195	1923	120	1924
	268	1926				
1913	225	1916	1,520	1917	1,584	1918
	460	1921	666	1923	75	1924
	235	1931	303	1940		
1916	1,091	1936	251	1937	608	1938
	277	1939				
1917	97	1937	472	1940		

2½-IN. GALVANIZED WROUGHT-IRON MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1911	185	185	0
1940	0	0	0
<hr/>			
TOTAL	185	185	0

3-IN. GALVANIZED WROUGHT-IRON MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1904	1,038	0	1,038
1911	235	60	175
1940	0	0	0
<hr/>			
TOTAL	1,273	60	1,213

3-IN. GALVANIZED WROUGHT-IRON MAINS
(contd.)

<i>Retirements by Years</i>		
<i>Year</i>		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1904	1,038	1911
1911	175	1940

1½-IN. BLACK WROUGHT-IRON MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	160	160	0
1940	0	0	0
TOTAL	160	160	0

2-IN. BLACK WROUGHT-IRON MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	1,676	1,676	0
1940	0	0	0
TOTAL	1,676	1,676	0

1-IN. LEAD MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1920	75	75	0
1924	50	50	0
1925	228	228	0
1926	65	65	0
1940	0	0	0
TOTAL	418	418	0

8-IN. TALBOT UNWRAPPED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	486	486	0
1940	0	0	0
TOTAL	486	486	0

Jamaica, New York

As of December 31, 1940

THE privately-owned Jamaica Water Supply Company serves an area in and around Jamaica, N.Y., which comprises most of the Fourth Ward and parts of the Second and Third Wards of Queens Borough (a part of New York City) and six villages and surrounding territory in the towns of Hempstead and North Hempstead in Nassau County. The total service area covers approximately 40 sq.mi. and contains a population of about 400,000.

The area served is predominantly residential in character, suburban to New York City. It does, however,

contain a considerable number of small diversified industries. As of the date of the study there were 86,148 services, 7,623 of which were metered. The distribution system consisted of 643 mi. of mains, from 2 to 24 in. in diameter, with 7,886 hydrants attached. The average pumpage during 1940 was 29.5 mgd., with a peak day of 41.9 mgd. Average use approximated 75 gpd. per capita.

Development of the Existing System

The Jamaica Water Supply Company was incorporated on Apr. 21,

TABLE 1
SUMMARY OF MAINS
JAMAICA, NEW YORK

Size, in.	Kind	No. of Feet Installed	Percent- age of Total	No. of Feet Retired	Percent- age of Total	No. of Feet in Service	Percent- age of Total	Year of First In- stallation	Average Age, yr.
4	Cast-iron unlined	111,985	3.2	28,853	29.7	83,132	2.5	1887	42.7
6		1,397,003	40.5	45,831	47.2	1,351,172	40.3	1887	22.9
8		1,518,359	44.0	12,855	13.2	1,505,504	44.9	1887	14.0
10		30,420	0.9	2,078	2.1	28,342	0.8	1887	33.9
12		310,243	9.0	6,606	6.8	303,637	9.0	1887	15.1
14		10,092	0.3	0	0.0	10,092	0.3	1910	22.4
16		73,607	2.1	944	1.0	72,663	2.2	1904	14.3
18		72	0.0	0	0.0	72	0.0	1930	10.5
20		1,332	0.0	0	0.0	1,332	0.0	1934	6.5
24		268	0.0	0	0.0	268	0.0	1935	5.5
TOTAL		3,453,381	100.0	97,167	100.0	3,356,214	100.0		18.6
Percentage of Total		100.00		2.81		97.19			
Average Size, in.		7.6		6.3		7.7			

TABLE 1 (contd.)
Mortality Survival Ratios

Size, in.	No. of Feet	Period Covered, yr.	Percentage
4	111,985	53.5	71.470
6	1,397,003	53.5	92.359
8	1,518,359	53.5	93.049
10 and 12	340,663	53.5	87.609
Over 12	85,371	36.5	96.963
Total	3,453,381		

1887, to supply water to the town of Jamaica in Queens County, New York. It was merged with the Jamaica Township Water Company, organized in 1888, on Aug. 20, 1902. The company not only expanded its territory in Queens County, but in 1899 extended its mains into Nassau County. In 1898, the city of New York annexed the company's territory in Queens County, which became Queens Borough and to which service is still rendered by the company.

The water sources of the company consist of 43 Layne gravel-wall wells located in various parts of its territory. Their depths vary from 63 to 614 ft. They have a daily average yield of 65 mil gal. The water is pumped from the wells by motor-driven centrifugal deep well pumps. Twenty-seven of the wells are pumped directly into the distribution system. The remaining sixteen pump into steel reservoirs or tanks from which motor driven units (one gasoline-engine-driven) pump to the distribution system. Water from four wells is treated in a slow sand filter and that from two wells in pressure filters. The supply at most stations is also treated with chlorine.

The storage reservoirs consist of four low-pressure steel tanks of 5.876-mil gal. total capacity and eleven high-

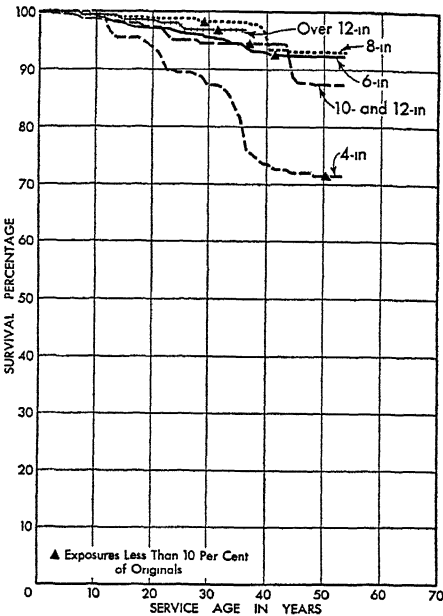


FIG. 1. Mortality Survival Curve—4-24-in.
Cast-Iron Unlined Mains—Jamaica,
New York

BASE: Feet	SURVIVAL: 1887-1940	
SIZE	EXPOSURES	RETIREMENTS
in.	ft.	ft.
4	111,985	28,853
6	1,397,003	45,831
8	1,518,359	12,855
10 and 12	340,663	8,684
Over 12	85,371	944

pressure steel tanks and standpipes of 9,856-mil.gal. capacity.

The pipe system is composed almost entirely of Class B cast-iron pipe.

Basis of Study

Work orders showing the record of installations and retirements of mains are complete since 1917 covering the record of 13 per cent of the existing mains. Prior to 1917, the record of main installation and retirement was obtained from a comprehensive study of old maps and records, dates of consumer applications, hydrant numbers, etc.

Mortality Survival Study

Mortality studies were made of cast-iron mains. Table 1 is a summary of the pipe installed, retired and that still in service, as well as other pertinent data. Figure 1 shows the mortality survival curves covering the record of

the amounts and sizes of pipe grouped as shown.

Causes of Retirement

While no special study was made of causes of retirement, it is a known fact in the experience of the company that the larger portion of the retirements were due to "requirements of public authorities." The territory has had a rapid growth and Queens Borough particularly has constantly undergone changes in street locations, widths and grades and construction of sewers, subways, super-highways, parks and housing developments—all requiring retirements of mains.

Acknowledgment

The collection and compilation of data in Jamaica were under the direction of Carter H. Lamb, Vice President, who at the time of the study was Valuation Engineer of the company.

SUMMARY OF INSTALLATIONS AND RETIREMENTS

JAMAICA, NEW YORK

MAINS

4-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet			Year Installed	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1887	443	443	0	1917	48	48	0
1891	25,151	15,639	9,512	1919	35	35	0
1892	12,997	10,947	2,050	1920	3	3	0
1893	5,776	3,376	2,400	1921	24	24	0
1894	8,876	5,610	3,266	1922	60	60	0
1895	3,374	2,610	764	1923	71	71	0
1896	5,364	4,812	552	1924	53	47	6
1897	2,727	2,727	0	1925	34	34	0
1898	7,750	2,299	5,451	1926	141	141	0
1899	19,117	17,434	1,683	1927	222	222	0
1900	1,645	685	960	1928	1,544	1,544	0
1902	291	19	272	1929	3	3	0
1904	2,670	2,670	0	1931	68	68	0
1905	6,367	5,756	611	1932	4	4	0
1906	1,525	1,022	503	1935	11	11	0
1910	3,898	3,078	820	1936	295	295	0
1911	380	380	0	1938	195	195	0
1912	3	0	3	1940	17	17	0
1913	350	350	0				
1915	453	453	0	TOTAL	111,985	83,132	28,853

Retirements by Years

Year							Year							
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year	
1891	1,305	1904	1,111	1910	70	1912	1896	22	1928	471	1932	59	1936	
	2,145	1913		70	1922	180	1923	1898	2,857	1910	1,583	1927	620	1931
	397	1925	1,609	1926	1,300	1927		391	1939					
	652	1928	398	1932	40	1935	1899	60	1904	43	1921	1,560	1935	
	235	1939						5	1938	15	1940			
1892	259	1910	537	1912	389	1926	1900	500	1928	460	1936			
	865	1931					1902	272	1939					
1893	30	1916	374	1917	1,292	1927	1905	611	1926					
	704	1931					1906	503	1927					
1894	70	1905	200	1912	237	1921	1910	250	1927	570	1931			
	528	1926	823	1927	93	1928	1912	3	1935					
	1,302	1930	13	1938			1924	6	1928					
1895	458	1904	15	1935	291	1939								

6-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet			Year Installed	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1887	23,250	21,082	2,168	1897	5,290	5,290	0
1888	4,477	4,477	0	1898	3,552	605	2,947
1891	27,656	24,487	3,169	1899	26,450	24,338	2,112
1892	24,743	21,367	3,376	1900	7,363	6,752	611
1893	4,951	4,017	934	1901	4,974	4,974	0
1894	22,001	16,126	5,875	1902	4,296	4,012	284
1895	9,329	9,087	242	1903	15,340	13,864	1,476
1896	8,621	6,678	1,943	1904	23,258	22,637	621

6-IN. CAST-IRON UNLINED MAINS (contd.)

Feet				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1905	28,522	26,494	2,028	1924	101,912	99,420	2,492
1906	9,559	9,495	64	1925	128,374	127,097	1,277
1907	3,517	2,497	1,020	1926	93,045	92,567	478
1908	51,191	50,560	631	1927	82,845	82,563	282
1909	38,443	36,977	1,466	1928	57,068	55,921	1,147
1910	60,420	59,007	1,413	1929	38,559	37,586	973
1911	85,942	84,588	1,354	1930	23,133	22,702	431
1912	59,900	59,309	591	1931	33,549	32,622	927
1913	37,624	36,696	928	1932	10,028	10,015	13
1914	5,492	4,529	963	1933	7,615	7,610	5
1915	7,367	7,183	184	1934	7,759	7,759	0
1916	7,527	7,235	292	1935	4,035	3,758	277
1917	6,359	6,334	25	1936	3,020	3,009	11
1918	4,888	4,888	0	1937	6,181	6,181	0
1919	7,782	7,737	45	1938	5,350	5,350	0
1920	4,108	4,098	10	1939	17,538	17,538	0
1921	16,782	16,598	184	1940	14,622	14,622	0
1922	35,400	35,395	5				
1923	75,996	75,439	557				
				TOTAL	1,397,003	1,351,172	45,831

Retirements by Years

Year				Year			
Installed	Feet	Year	Feet	Installed	Feet	Year	Feet
1887	853	1904	648	1912	15	1920	237
	440	1928	45		39	1935	7
1891	648	1906	985	1913	200	1924	712
	41	1929	405		3	1938	8
1892	1,959	1904	1,070	1914	946	1923	17
	10	1936	16	1915	184	1933	
1893	934	1906		1916	292	1928	
1894	3,165	1904	2,215	1917	25	1940	
	388	1925	10	1919	42	1934	3
1895	236	1904	6	1920	10	1935	
1896	600	1905	88	1921	180	1933	4
	723	1929		1922	2	1936	3
1898	285	1904	2,658	1923	17	1937	540
1899	1,826	1912	201	1924	493	1927	905
	41	1937	24		12	1936	1
1900	144	1919	452		1,017	1939	
1902	284	1927		1925	789	1927	230
1903	355	1911	1,121		15	1936	9
1904	291	1931	3		11	1940	
1905	265	1924	272	1926	15	1935	10
	6	1935	2		32	1939	207
1906	60	1916	4	1927	204	1929	51
1907	290	1927	730		23	1939	
1908	220	1924	18	1928	546	1934	125
	11	1936	7		422	1940	
	25	1939		1929	5	1935	6
1909	343	1931	334	1930	3	1936	428
	771	1938		1931	6	1936	431
1910	48	1935	14	1932	5	1935	8
	1,348	1939		1933	5	1936	
1911	17	1930	218	1935	4	1937	13
	15	1936	297	1936	1	1937	10
	525	1939	265				

SURVIVAL AND RETIREMENT

8-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet			Year Installed	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1887	3,175	2,993	182	1919	4,748	4,748	0
1888	3,140	3,140	0	1920	4,410	4,405	5
1891	16,316	15,673	643	1921	12,890	12,885	5
1892	2,636	2,636	0	1922	26,082	25,899	183
1893	10,240	10,240	0	1923	48,518	48,175	343
1896	416	413	3	1924	89,364	89,096	268
1899	10,102	8,413	1,689	1925	160,884	160,384	500
1901	769	769	0	1926	171,170	169,513	1,657
1902	11,663	11,663	0	1927	154,548	153,593	955
1903	5,461	5,439	22	1928	112,342	110,942	1,400
1904	4,730	4,660	70	1929	75,514	73,842	1,672
1905	5,345	5,345	0	1930	68,060	67,797	263
1907	3,659	3,659	0	1931	71,233	71,166	67
1908	10,189	10,189	0	1932	32,566	31,836	730
1909	13,123	13,117	6	1933	14,444	14,382	62
1910	8,059	8,035	24	1934	23,766	23,299	467
1911	11,080	10,203	877	1935	19,511	19,221	290
1912	32,833	32,814	19	1936	34,475	34,455	20
1913	8,833	8,833	0	1937	45,904	45,498	406
1914	603	597	6	1938	57,266	57,261	5
1915	2,382	2,382	0	1939	63,678	63,666	12
1916	6,373	6,373	0	1940	53,389	53,389	0
1917	1,474	1,474	0				
1918	996	992	4	TOTAL	1,518,359	1,505,504	12,855

Retirements by Years

Year				Year			
Installed	Feet	Year	Feet	Installed	Feet	Year	Feet
1887	181	1931	1	1926	137	1931	175
1891	228	1928	415		14	1935	83
1896	3	1937			1,211	1939	
1899	12	1936	2	1927	285	1929	9
1903	22	1936			3	1937	640
1904	6	1936	12	1928	209	1934	3
1909	6	1936			8	1937	1,171
1910	24	1936		1929	84	1932	95
1911	256	1931	6		625	1938	810
1912	4	1935	12		12	1935	200
1914	6	1935			5	1938	41
1918	4	1936		1931	4	1935	23
1920	5	1935			546	1935	171
1921	5	1938		1933	47	1937	15
1922	60	1925	115		11	1936	291
	4	1937		1935	5	1937	120
1923	12	1937	331		3	1937	9
1924	252	1928	14	1937	9	1938	397
1925	31	1935	19		5	1939	
	337	1939	31	1939	12	1940	

10-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet			Year Installed	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1887	4,821	4,055	766	1934	557	557	0
1888	2,731	2,731	0	1935	11	11	0
1891	3,229	2,416	813	1936	5	5	0
1904	6,679	6,679	0	1938	20	20	0
1912	2,641	2,161	480	1939	63	63	0
1917	836	836	0	1940	0	0	0
1919	2	0	2				
1920	2	2	0	TOTAL	30,420	28,342	2,078
1922	2,599	2,595	4				
1923	4,336	4,336	0				
1924	1,416	1,413	3				
1925	47	47	0				
1926	3	3	0				
1927	17	17	0				
1928	19	19	0				
1929	91	91	0				
1930	117	107	10				
1931	132	132	0				
1932	17	17	0				
1933	29	29	0				

Retirements by Years				
Year Installed	Feet	Year	Feet	Year
1887	740	1910	26	1932
1891	813	1935		
1912	474	1934	6	1936
1919	2	1935		
1922	4	1936		
1924	3	1936		
1930	10	1938		

12-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet			Year Installed	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1887	4,487	4,257	230	1938	8,255	8,255	0
1904	13,358	12,867	491	1939	17,825	17,813	12
1905	2,375	2,375	0	1940	9,433	9,433	0
1906	3,590	3,590	0				
1909	5,702	5,702	0	TOTAL	310,243	303,637	6,606
1910	22,723	22,114	609				
1911	1,897	1,897	0				
1912	7,407	6,610	797				
1917	1,359	1,356	3				
1918	12	12	0				
1920	3	3	0				
1921	288	288	0				
1922	300	300	0				
1923	9,046	9,046	0				
1924	26,943	26,511	432				
1925	19,638	19,303	335				
1926	9,620	9,611	9				
1927	23,272	22,957	315				
1928	30,222	29,882	340				
1929	23,442	21,930	1,512				
1930	23,009	22,189	820				
1931	8,131	7,980	151				
1932	10,596	10,596	0				
1933	2,174	2,162	12				
1934	3,435	3,422	13				
1935	3,004	3,004	0				
1936	11,552	11,533	19				
1937	7,145	6,639	506				

Retirements by Years						
Year Installed	Feet	Year	Feet	Year	Feet	Year
1887	92	1931	133	1932	5	1935
1904	491	1932				
1910	605	1928	4	1936		
1912	753	1934	11	1935	33	1937
1917	3	1935				
1924	8	1935	16	1936	18	1937
	390	1939				
1925	291	1933	44	1940		
1926	9	1939				
1927	5	1937	310	1939		
1928	2	1937	338	1939		
1929	1,437	1936	75	1939		
1930	768	1936	52	1939		
1931	147	1936	4	1939		
1933	12	1939				
1934	12	1934	1	1937		
1936	19	1939				
1937	506	1939				
1939	12	1940				

14-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	6,276	6,276	0
1922	348	348	0
1923	3	3	0
1927	3	3	0
1928	10	10	0
1929	1,992	1,992	0
1932	8	8	0
1935	516	516	0
1938	684	684	0
1940	252	252	0
TOTAL	10,092	10,092	0

16-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1904	5,063	4,872	191
1910	5,222	4,775	447
1912	557	557	0
1918	436	436	0
1922	4,944	4,684	260
1923	1,260	1,242	18
1924	4,396	4,396	0
1925	9,590	9,586	4
1927	1,668	1,668	0
1928	8,052	8,052	0
1929	845	831	14
1930	1,835	1,835	0
1931	7,540	7,540	0
1932	12,993	12,985	8
1933	766	764	2
1934	339	339	0
1935	822	822	0
1938	4,012	4,012	0
1939	2,244	2,244	0
1940	1,023	1,023	0
TOTAL	73,607	72,663	944

16-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years						
Year	Feet	Year	Feet	Year	Feet	Year
1904	185	1929	3	1936	3	1937
1910	380	1924	67	1931		
1922	256	1929				
1923	18	1938				
1925	4	1936				
1929	14	1933				
1932	8	1935				
1933	2	1940				

18-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	72	72	0
1940	0	0	0
TOTAL	72	72	0

20-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1934	1,332	1,332	0
1940	0	0	0
TOTAL	1,332	1,332	0

24-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1935	268	268	0
1940	0	0	0
TOTAL	268	268	0

Merrick, New York

As of December 31, 1940

THE Merrick-Massapectua plant of the New York Water Service Corporation, a private utility, furnishes water service to the southern part of the town of Oyster Bay, including the communities of Merrick, North Merrick, Bellmore, North Bellmore, Wantagh, Seaford, Massapequa and environs, all lying in Nassau County, Long Island, adjacent to the New York City limits. The area served is predominately residential.

As of the date of the study the company served 3,500 customers, representing a population of about 21,000. Sales averaged 0.83 mgd., or about 39 gpd. per capita.

Development of the Existing System

The Merrick Water Company, serving the village of Merrick and surrounding area was incorporated in 1895. In April 1912, the Hempstead and Oyster Bay Water Company was incorporated and its directors and stockholders at their first meeting resolved to purchase the stock of the Merrick Water Company. The merger was consummated in July 1912, under the name of the Hempstead and Oyster Bay Water Company.

In February 1926, Francis W. Collins acquired control of the company. His interest was purchased in 1930 by the New York Water Service Corporation, a subsidiary of the present Federal Water & Gas Corporation, and the

company became first the Merrick plant and later the Merrick-Massapectua plant of the New York Water Service Corporation.

The source of water supply has always come from wells. The original supply, developed in 1895, was located in the present village of Merrick and continued in use with the pumping station until 1923. A new supply, consisting of four wells and a pumping station, was constructed at this time in Merrick and continued in use until 1938, when two new driven wells, with a combined average yield of 1 mgd., were developed. These wells are 12 in. in diameter and approximately 45 ft. deep, with 8-in. drop pipes. The supply is pumped from the wells directly into the distribution system by two 750-gpm. centrifugal pumps driven by 50-hp. diesel oil engines installed in 1923 and 1924.

In 1928 a new supply was developed, with a Hart open well, 13 ft. in diameter, 18 ft. deep to a gravel fill which extends 21 ft. lower, in Massapequa. In 1936 a new gravel-pack well was developed adjacent to the Hart well. This well is 28 in. in diameter, 73 ft. deep, with casing to 42 ft. and an inner casing 16 in. in diameter, 43 ft. deep, with a 30-ft. strainer. The two wells have an average yield of approximately 1.73 mgd.

The Hart well is pumped by a 750-gpm. centrifugal pump belt driven by a

TABLE 1
SUMMARY OF MAINS
MERRICK, NEW YORK

Size, in.	Kind	Number of Feet Installed	Percent- age of Total	Number of Feet Retired	Percent- age of Total	Number of Feet in Service	Percent- age of Total	Year of First In- stallation	Average Age, yr.
4	Cast-iron unlined	45,250	13.7	36*	21.8	45,214	13.7	1912	20.6
6		87,389	26.4	73†	44.3	87,316	26.4	1912	15.2
8		29,033	8.8	0	0	29,033	8.8	1922	13.7
12		61,349	18.6	56‡	33.9	61,293	18.6	1926	12.4
4	Cast-iron cement-lined	99	0.0	0	0	99	0.0	1931	5.7
6		70,998	21.5	0	0	70,998	21.5	1931	6.1
8		28,446	8.6	0	0	28,446	8.6	1931	7.9
10		49	0.0	0	0	49	0.0	1937	3.5
12		7,820	2.4	0	0	7,820	2.4	1931	8.5
TOTAL		330,433	100.0	165	100.0	330,268	100.0		12.5
Percentage of Total		100.00		0.05		99.95			
Average Size, in.		7.33		7.6		7.33			

Mortality Survival Ratios

Size, in.	Kind	Number of Feet	Period Covered, yr.	Percentage
4	Cast-iron unlined	45,250	28.5	99.823
6		87,389	28.5	99.916
8		29,033	18.5	100.000
12		61,349	14.5	99.909
4-12	Cast-iron cement-lined	107,412	9.5	100.000
Total		330,433		

* 9 ft. retired at 8.5 years and 27 ft. at 24.5 years because of sewer construction. Salvaged.

† 9 ft. retired at 6.5 years, 39 ft. at 7.5 years and 25 ft. at 8.5 years because of sewer construction. Salvaged.

‡ 18 ft. retired at 5.5 years because valve installed. Salvaged. 38 ft. retired at 5.5 years because tee inserted. 36 ft. salvaged.

55-hp. diesel oil engine direct to the distribution system. This well also has installed a deep well pump of 440-gpm. capacity driven by a 25-hp. motor installed in 1931. The gravel-pack well is equipped with a low-lift deep well pump of 700-gpm. capacity and is driven by a 10-hp. electric motor installed in 1936. The pump discharges through a steel riffle-type aerator to a concrete clear water basin. A 700-

gpm. centrifugal pump driven by a 40-hp. electric motor then takes its suction from the basin and pumps to the distribution system.

Water storage facilities in the system include an elevated steel tank 19 ft. in diameter by 17.5 ft. deep, with a capacity of 50,000 gal., which was erected in 1922; and another one 38 ft. in diameter by 17.5 ft. deep, with a capacity of 200,000 gal. erected in 1924.

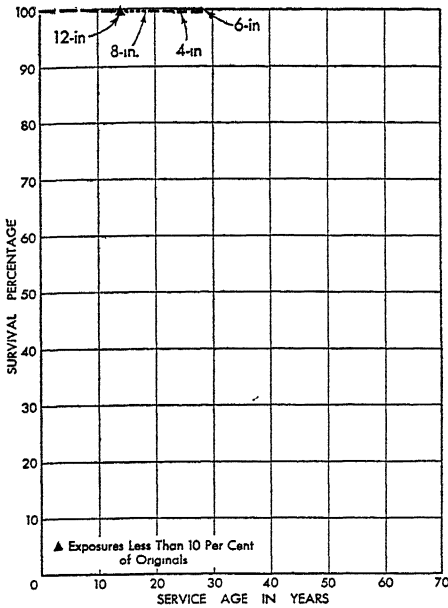


FIG. 1. Mortality Survival Curve—4-12-in. Cast-Iron Unlined Pipe—Merrick, New York

BASE: Feet SIZE <i>in.</i>	EXPOSURES <i>ft.</i>	SURVIVAL: 1912-1940 RETIREMENTS <i>ft.</i>
4	45,250	36
6	87,389	73
8	29,033	0
12	61,349	56

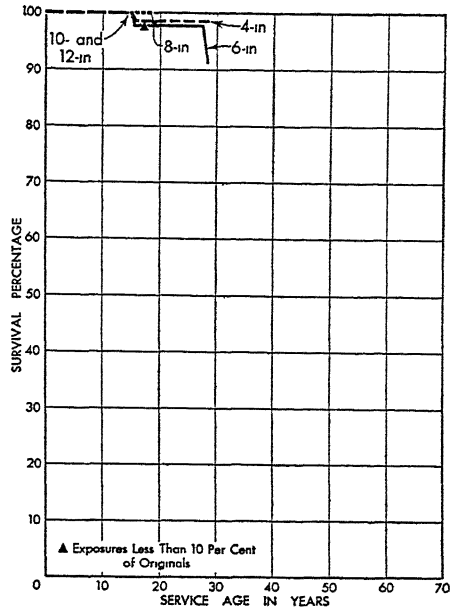


FIG. 2. Mortality Survival Curve—4-12-in. Valves—Merrick, New York

BASE: Unit SIZE <i>in.</i>	EXPOSURES <i>Units</i>	SURVIVAL: 1912-1940 RETIREMENTS <i>Units</i>
4	82	1
6	295	2
8	74	0
10 and 12	70	0

TABLE 2

SUMMARY OF VALVES

MERRICK, NEW YORK

Size, <i>in.</i>	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, <i>yr.</i>
4	82	1*	81	1912	18.8
6	295	2†	293	1912	10.7
8	74	0	74	1922	10.4
10	1	0	1	1937	3.5
12	69	0	69	1926	11.6
TOTAL	521	3	518		12.0
Percentage of Total	100.00	0.58	99.42		

TABLE 2 (contd.)
Mortality Survival Ratios

Size, in.	Number Installed	Period Covered, yr.	Percentage
4	82	28.5	98.413
6	295	28.5	90.881
8	74	18.5	100.000
10-12	70	14.5	100.000

* One retired at 15.5 years because of leaking. Scrapped.

† One retired at 28.5 years because of leaking and one retired at 15.5 years because broken. Both scrapped.

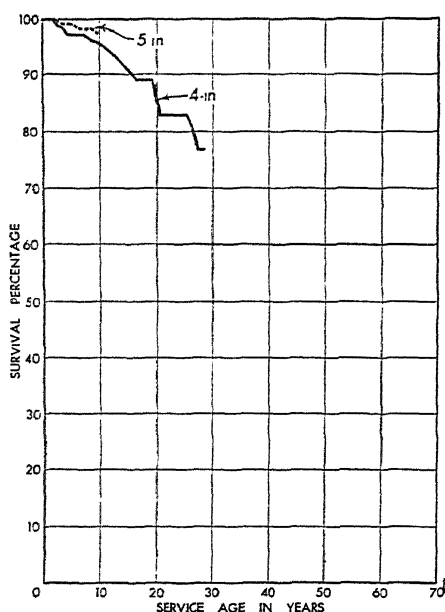


FIG. 3. Mortality Survival Curve—4- and 5-in. Hydrants—Merrick, New York

BASE: Unit		SURVIVAL: 1912-1940	
SIZE	EXPOSURES	RETIREMENTS	
in.	Units	Units	
4	388	36	
5	228	4	

Both tanks are located at the pump site in the village of Merrick.

The distribution system, as of the date of the study, consisted of approxi-

mately 78 mi. of $\frac{3}{4}$ - to 12-in. pipe of cast iron, wrought iron, steel and copper. It has 449 valves and 576 hydrants.

Basis of Study

In 1913, under the terms of a contract with the town of Hempstead, it was necessary to replace a large portion of the original mains with pipe of larger size, to lay new mains and install fire hydrants. Available records of the Merrick Water Company do not give even a partially complete record of the original main installation.

This study is therefore confined to a study of mains, valves and hydrants installed and retired from 1912 to the date of the study.

Mortality Survival Study

The mortality survival study is confined to cast-iron mains, valves and hydrants installed since 1912. Table 1 is a summary of pipe installed, retired and still in service, as well as of other pertinent data relative to the cast-iron pipe. Figure 1 shows the mortality survival curves covering the grouping of mains shown.

Tables 2 and 3 show the summaries of valves and hydrants with Figs. 2 and 3 representing the corresponding mortality survival curves.

TABLE 3
SUMMARY OF HYDRANTS
MERRICK, NEW YORK

Size, in.	Kind	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, yr.
4	Two 2½-in. Hose Nozzle	387	36	351	1912	14.4
4	Two 2½-in. Hose and Steamer Nozzle	1	0	1	1939	1.5
5	Two 2½-in. Hose Nozzle	148	0	148	1931	7.1
5	Two 2½-in. Hose and Steamer Nozzle	80	4	76	1931	6.6
TOTAL		616	40	576		11.5
Percentage of Total		100.00	6.5	93.5		

Mortality Survival Ratios

Size, in.	Number Installed	Period Covered, yr.	Percentage
4	388	28.5	76.538
5	228	9.5	97.483
TOTAL	616		

NOTE: Majority of retirements were due to relocation, or damage by automobile and, after repair, generally set up again.

Causes of Retirement

The recorded causes of retirement of cast-iron pipe are shown in the footnote in Table 1. A similar footnote in Table 2 gives the reasons for the retirement of valves.

Acknowledgment

The collection and compilation of the data for the Merrick-Massapequa plant were under the general direction of E. L. Heyser, Chief Valuation Engineer, New York Water Service Corporation.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
MERRICK, NEW YORK

MAINS

4-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	14,558	14,531	27
1913	963	963	0
1915	1,684	1,684	0
1922	180	180	0
1923	3,167	3,167	0
1924	12,462	12,462	0
1925	6,076	6,067	9
1926	5,429	5,429	0
1927	10	10	0
1928	721	721	0
1940	0	0	0
<hr/>			
TOTAL	45,250	45,214	36

Retirements by Years

<i>Year</i>	<i>Feet</i>	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1912	27	1936
1925	9	1933

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	9,924	9,924	0
1922	3,383	3,383	0
1924	6,256	6,256	0
1925	7,374	7,374	0
1926	3,343	3,343	0
1927	18,659	18,625	34
1928	26,422	26,414	8
1929	9,216	9,185	31
1930	2,812	2,812	0
1940	0	0	0
<hr/>			
TOTAL	87,389	87,316	73

Retirements by Years

<i>Year</i>	<i>Feet</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1927	9	1933	25	1935
1928	8	1935		
1929	31	1936		

8-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1922	710	710	0
1923	9,382	9,382	0
1924	266	266	0
1927	2,609	2,609	0
1928	4,695	4,695	0
1929	3,736	3,736	0
1930	6,835	6,835	0
1931	800	800	0
1940	0	0	0
<hr/>			
TOTAL	29,033	29,033	0

12-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	958	958	0
1927	7,176	7,176	0
1928	34,951	34,913	38
1929	18,225	18,207	18
1930	39	39	0
1940	0	0	0
<hr/>			
TOTAL	61,349	61,293	56

Retirements by Years

<i>Year</i>	<i>Feet</i>	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1928	38	1933
1929	18	1934

4-IN. CAST-IRON CEMENT-LINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	14	14	0
1933	9	9	0
1935	43	43	0
1936	27	27	0
1939	6	6	0
1940	0	0	0
<hr/>			
TOTAL	99	99	0

6-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	31,511	31,511	0
1932	4,301	4,301	0
1933	2,137	2,137	0
1935	1,073	1,073	0
1936	6,487	6,487	0
1937	7,058	7,058	0
1938	2,631	2,631	0
1939	8,888	8,888	0
1940	6,912	6,912	0
TOTAL	70,998	70,998	0

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	21,607	21,607	0
1933	253	253	0
1936	2,398	2,398	0
1937	1,106	1,106	0
1938	342	342	0
1939	417	417	0
1940	2,323	2,323	0
TOTAL	28,446	28,446	0

10-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1937	49	49	0
1940	0	0	0
TOTAL	49	49	0

12-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	3,931	3,931	0
1932	3,049	3,049	0
1934	18	18	0
1937	822	822	0
1940	0	0	0
TOTAL	7,820	7,820	0

VALVES

4-IN. VALVES

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	22	22	0
1913	1	1	0
1915	3	3	0
1923	5	5	0
1924	21	21	0
1925	11	10	1
1926	10	10	0
1927	2	2	0
1928	1	1	0
1931	1	1	0
1939	4	4	0
1940	1	1	0
TOTAL	82	81	1

Retirements by Years

Year	Number	
<i>Installed</i>	<i>Number</i>	<i>Year</i>
1925	1	1940

6-IN. VALVES

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	14	13	1
1922	3	3	0
1924	15	15	0
1925	15	14	1
1926	4	4	0
1927	33	33	0
1928	53	53	0
1929	27	27	0
1930	5	5	0
1931	50	50	0
1932	8	8	0
1933	4	4	0
1935	1	1	0
1936	9	9	0
1937	11	11	0
1938	5	5	0
1939	17	17	0
1940	21	21	0
TOTAL	295	293	2

SURVIVAL AND RETIREMENT

6-IN. VALVES (contd.)

Retirements by Years

Year Installed	Number	Year	Number
1912	1	1940	
1925	1	1940	

8-IN. VALVES

Year Installed	Number		
	Installed	In Service	Retired
1922	1	1	0
1923	7	7	0
1924	2	2	0
1927	3	3	0
1928	12	12	0
1929	7	7	0
1930	7	7	0
1931	23	23	0
1936	2	2	0
1937	6	6	0
1938	1	1	0
1940	3	3	0
TOTAL	74	74	0

10-IN. VALVES

Year	Number		
Installed	Installed	In Service	Retired
1937	1	1	0
1940	0	0	0
TOTAL	1	1	0

12-IN. VALVES

Year	Number		
Installed	Installed	In Service	Retired
1926	1	1	0
1927	9	9	0
1928	34	34	0
1929	16	16	0
1931	2	2	0
1932	2	2	0
1934	1	1	0
1937	4	4	0
1940	0	0	0
TOTAL	69	69	0

HYDRANTS

4-IN. HYDRANTS—TWO HOSE NOZZLES

Year	Number		
Installed	Installed	In Service	Retired
1912	40	34	6
1913	2	2	0
1915	3	3	0
1922	2	2	0
1923	22	21	1
1924	38	33	5
1925	27	22	5
1926	18	18	0
1927	59	56	3
1928	74	61	13
1929	42	41	1
1930	25	25	0
1931	8	6	2
1932	1	1	0
1933	5	5	0
1935	3	3	0
1936	2	2	0
1937	2	2	0
1938	1	1	0
1939	12	12	0
1940	1	1	0
TOTAL	387	351	36

4-IN. HYDRANTS—TWO HOSE NOZZLES (contd.)

Retirements by Years

Year	Num-	Year	Num-	Year	Num-
Installed	ber	Year	ber	Year	ber
1912	3	1932	1	1938	2
1923	1	1939			
1924	3	1936	1	1937	1
1925	1	1933	1	1935	2
	1	1940			
1927	2	1931	1	1940	
1928	5	1931	1	1932	1
	1	1936	1	1937	1
	2	1939	1	1940	
1929	1	1931			
1931	1	1933	1	1939	

4-IN. HYDRANTS—TWO HOSE AND ONE STEAMER NOZZLE

Year	Number		
Installed	Installed	In Service	Retired
1939	1	1	0
1940	0	0	0
TOTAL	1	1	0

5-IN. HYDRANTS—TWO HOSE AND
ONE STEAMER NOZZLE

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	41	40	1
1932	7	6	1
1935	2	2	0
1936	2	1	1
1937	10	9	1
1938	4	4	0
1939	5	5	0
1940	9	9	0
TOTAL	80	76	4

Retirements by Years

<i>Year</i>	<i>Number</i>	
<i>Installed</i>	<i>Year</i>	
1931	1	1940
1932	1	1938
1936	1	1938
1937	1	1939

5-IN. HYDRANTS—TWO HOSE NOZZLES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	83	83	0
1932	12	12	0
1933	2	2	0
1935	2	2	0
1936	12	12	0
1937	11	11	0
1938	4	4	0
1939	14	14	0
1940	8	8	0
TOTAL	148	148	0

Norwich, New York

As of December 31, 1940

THE Norwich plant of the New York Water Service Corporation renders water service to the city of Norwich, N.Y., and adjacent areas in the town of Norwich.

Norwich, the county seat of Chenango County, is located in the south central part of the state, about 55 mi. southeast of Syracuse. The Chenango River flows through the city. It is a local trading center, largely residential but with some small industries.

As of Dec. 31, 1940, there were 2,119 metered customers being served by the

plant in a territory having a population of about 8,800 people. Consumption during the year averaged approximately 0.52 mgd., equivalent to 59 gpd. per capita.

Development of the Existing System

The original plant was incorporated as the Norwich Water Works in January 1881. The works were constructed during that year and water service commenced a year later. In 1926 the New York Water Service Corporation acquired the Norwich Water Works

TABLE 1
SUMMARY OF MAINS
NORWICH, NEW YORK

Size, <i>in.</i>	Kind	No. of Feet In- stalled	Percent- age of Total	No. of Feet Retired	Percent- age of Total	No. of Feet in Service	Percent- age of Total	Year of First In- stallation	Average Age, <i>yr.</i>
4	Cast-iron unlined	46,498	33.4	793	29.0	45,705	33.4	1881	45.3
6		46,122	33.0	224	8.2	45,898	33.5	1881	42.7
8		9,332	6.7	0	.	9,332	6.8	1881	54.6
10		8,207	5.9	0		8,207	6.0	1881	53.7
12		14,219	10.2	1,717	62.8	12,502	9.1	1881	48.3
14		7,002	5.0	0		7,002	5.1	1902	38.5
16		1,734	1.2	0		1,734	1.3	1902	37.5
18		784	0.6	0		784	0.6	1902	38.5
4	Cast-iron cement-lined	203	0.1	0		203	0.1	1930	7.1
6		2,560	1.8	0		2,560	1.9	1930	5.6
8		1,301	0.9	0		1,301	1.0	1936	3.7
12		1,514	1.1	0		1,514	1.1	1938	2.5
12	Wrought-iron	137	0.1	0		137	0.1	1936	4.5
TOTAL		139,613	100.0	2,734	100.0	136,879	100.0		43.6
Percentage of Total		100.00		1.96		98.04			
Average Size, <i>in.</i>		6.99		9.19		6.95			

TABLE 1 (contd.)
Mortality Survival Ratios

Size, in.	Kind	No. of Feet	Period Covered, yr.	Percentage
4	Cast-iron unlined	46,498	59.5	98.221
6		46,122	59.5	99.253
8		9,332	59.5	100.000
10 and 12		22,426	59.5	87.212
Over 12	Cast-iron cement-lined	9,520	38.5	100.000
4-12		5,578	10.5	100.000
12	Wrought-iron	137	4.5	100.000
	TOTAL	139,613		

TABLE 2
SUMMARY OF VALVES
NORWICH, NEW YORK

Size, in.	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, yr.
4	122	5	117	1881	42.1
6	101	0	101	1881	38.1
8	16	0	16	1881	47.9
10	11	0	11	1881	43.4
12	23	1	22	1881	25.7
14	2	1	1	1902	38.5
16	2	0	2	1902	33.0
TOTAL	277	7	270		39.6
Percentage of Total	100.00	2.53	97.47		

Mortality Survival Ratios

Size, in.	Number Installed	Period Covered, yr.	Percentage
4	122	59.5	95.216
6	101	59.5	100.000
8	16	59.5	100.000
10 and 12	34	59.5	87.500
Over 12	4	38.5	66.667
TOTAL	277		

and in May 1929 it was merged with and became the Norwich plant of the New York Water Service Corporation, which has a number of other plants within the state. This corporation was

a part of the Federal Water Service Corporation, now the Federal Water & Gas Corporation.

In 1881 the original source of water developed was on Ransford Creek, lo-

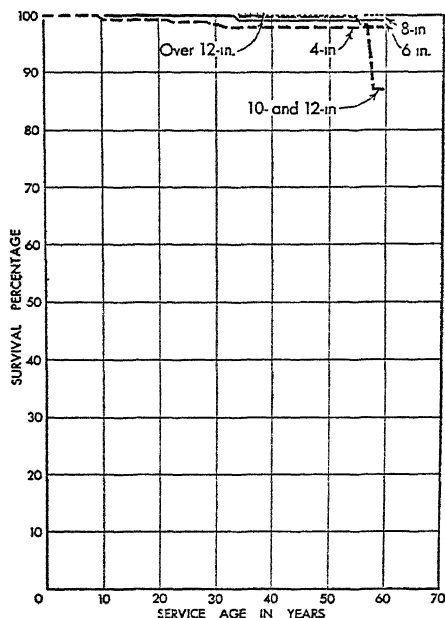


FIG. 1. Mortality Survival Curve—4-18-in. Cast-Iron Unlined Mains—Norwich, New York

BASE: Feet SIZE	SURVIVAL: 1881-1940	
in.	EXPOSURES ft.	RETIREMENTS ft.
4	46,498	793
6	46,122	224
8	9,332	0
10 and 12	22,426	1,717
Over 12	9,520	0

cated in the town of Norwich about $1\frac{1}{4}$ mi. northeast of the city. A reservoir, now known as Lower Reservoir No. 1, having a surface area of 6.5 acres, was formed by an earthen dam approximately 40 ft. high and 240 ft. long, receiving the drainage from 4 sq.mi. of watershed. Water was fed, without other treatment than natural settlement, through a 12-in. cast-iron main, approximately 6,500 ft. long, to the distribution system.

During 1890 and 1891, additional impoundment became necessary and a

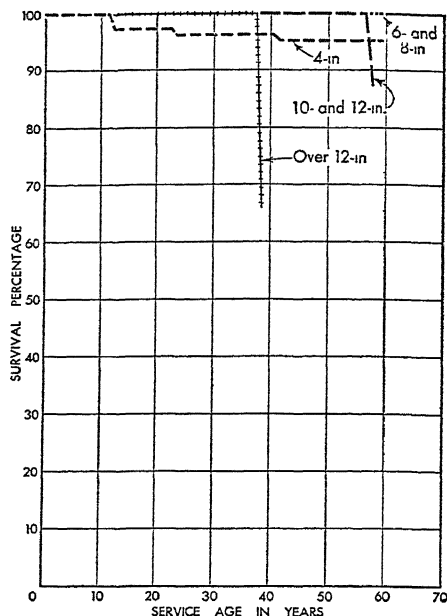


FIG. 2. Mortality Survival Curve—4-16-in. Valves—Norwich, New York

BASE: Unit SIZE	SURVIVAL: 1881-1940	
in.	EXPOSURES Units	RETIREMENTS Units
4	122	5
6	101	0
8	16	0
10 and 12	34	1
Over 12	4	1

second, or upper Reservoir No. 2, was built east of the original reservoir. The new reservoir has a surface area of 9 acres formed by a 50-ft. earthen dam, 612 ft. long, 54 ft. in elevation above Reservoir No. 1. The 12-in. transmission main was extended to Reservoir No. 2, but generally the discharge is from the upper reservoir through a series of aerating nozzles to the lower reservoir.

During 1901 an additional source of supply was obtained by purchasing certain water rights at Chenango Lake,

TABLE 3
SUMMARY OF HYDRANTS
NORWICH, NEW YORK

Size, in.	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, yr.	Mortality Survival Percentage
4 and 5	167	53	114	1881	19.0	5.983
TOTAL	167	53	114			
Percentage of Total	100.00	31.74	68.26			

located 3 mi. northeast of Reservoir No. 1, in the town of New Berlin. Chenango Lake, with a lake surface of about 130 acres, has a drainage area of 0.78 sq.mi. The water rights acquired allowed the company to lower the water in the lake 7 ft. below normal. Water from Chenango Lake is transmitted through a 761-ft. long rock tunnel, and a 14-, 16- and 18-in. di-

ameter pipeline 9,630 ft. to a branch of Ransford Creek down which it flows another 8,000 ft. to Reservoir No. 2.

The combined impounding capacity of the two reservoirs and Chenango Lake is approximately 314 mil.gal., of which approximately 310 mil.gal. is available for use.

A second 12-in. cast-iron transmission main was installed from Reservoir

TABLE 4
CAUSES OF RETIREMENTS OF MAINS
NORWICH, NEW YORK

Size, in.	Length, ft.	Life, yr.	Cause of Retirement	Salvage, ft.
4	283	10.5	No longer needed	283
	6	12.5	Replaced by 10-in. main	6
	129	22.5	No longer needed	129
	205	29.5	No longer needed	—
	170	31.5	Relocated because of freezing	—
	793			418
6	224	34.5	Relocated because of new bridge	60
	224			60
12	12	34.5	Relocation of State Highway Salvaged, sold and used by plant on Long Island	12
	230	53.5		103
	1,475	57.5		1,475
	1,717			1,590

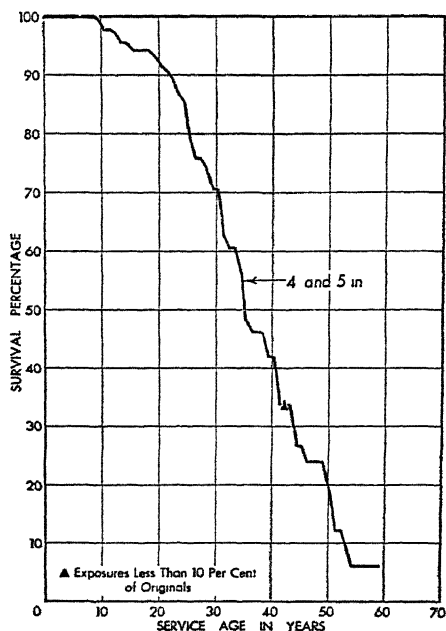


FIG. 3. Mortality Survival Curve—4- and 5-in. Hydrants—Norwich, New York

BASE: Unit	SURVIVAL: 1881-1940
SIZE	EXPOSURES RETIREMENTS
in.	Units Units
4 and 5	167 53

No. 2 to the city in 1904. Both lines are approximately equivalent to existing Class A thickness.

In 1910 there was a shortage of water and therefore, in 1911, a small pumping station was installed to take water from Chenango River. Subsequently this station was dismantled and, in 1913, a standby supply was developed by installing an intake in Chenango River within the city. Water flowed by gravity through 409 ft. of 12-in. cast-iron and terra cotta pipe to a concrete suction well, 14 ft. in diameter by 19 ft. deep. In emergencies the water was pumped through pressure filters by a turbine type pump

of 2,800-gpm. capacity. This emergency supply has not been used for some time and the electric motor has been transferred to another plant.

The original supply of water was delivered to consumers without treatment until 1905. In that year a filter plant was installed in the town of Norwich about 400 ft. east of the Norwich city limits. It consisted of four horizontal, rapid-sand pressure filters. Two additional filters were added in 1907. Chemical application equipment was added in 1924 and 1929.

The distribution and transmission system consists of approximately 26.7 mi. of cast-iron pipe from 4 to 18 in. in diameter and $\frac{3}{4}$ - to 2-in. wrought-iron and copper pipe. It has 270 valves and 230 fire hydrants.

Basis of Study

The records of pipe, valve and hydrant installations and retirements are substantially complete from the beginning of the system.

Mortality Survival Study

Mortality studies were made of cast-iron mains, valves and hydrants. Table 1 gives a summary of the pipe installed, retired and the amount remaining in service, as well as other pertinent data. Figure 1 shows the mortality survival curves covering the record of the pipe grouped as shown.

Tables 2 and 3 give summaries of valves and hydrants and Figs. 2 and 3 show the applicable mortality survival curves.

Causes of Retirement

The causes of retirement of mains and valves respectively are shown in Tables 4 and 5.

TABLE 5
CAUSES OF RETIREMENTS OF VALVES
NORWICH, NEW YORK

Size, <i>in.</i>	Number Retired	Life, <i>yr.</i>	Cause of Retirement	Number Salvaged
4	2	12.5	Replaced with 10-in. main	—
	1	12.5	Renewed	—
	1	23.5	Blowoff line removed	1
	1	41.5	Retired	—
	<u>5</u>			<u>1</u>
12	1	57.5	Relocation of State Highway	1
	<u>1</u>			<u>1</u>
14	1	38.5	Leaking, scrapped	0
	<u>1</u>			<u>0</u>

It was stated that the majority of retirements of hydrants were due to relocation or to damage by automobiles, in which cases the hydrants were inspected, repaired where necessary, and set in other installations.

Acknowledgment

The collection and compilation of the data in the Norwich plant were under the supervision of E. L. Heyser, Chief Valuation Engineer of the New York Water Service Corporation.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
NORWICH, NEW YORK

MAINS

4-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	6,610	6,399	211	1910	489	489	0
1883	774	774	0	1911	359	359	0
1884	980	980	0	1912	1,268	1,268	0
1885	1,323	1,323	0	1913	79	79	0
1886	1,152	1,152	0	1914	12	12	0
1889	834	834	0	1916	137	137	0
1891	4,709	4,709	0	1918	155	155	0
1892	2,752	2,752	0	1922	6	6	0
1893	3,391	3,262	129	1924	59	59	0
1894	5,306	5,306	0	1925	1,068	1,068	0
1895	1,423	1,423	0	1927	267	267	0
1896	396	396	0	1940	0	0	0
1897	1,849	1,849	0				
1899	156	156	0	TOTAL	46,498	45,705	793
1900	24	24	0				
1901	1,130	1,130	0	<i>Retirements by Years</i>			
1902	2,172	2,172	0	<i>Year</i>			
1903	2,100	1,930	170	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1904	1,220	1,220	0	1881	6	1893	205
1905	825	542	283	1893	129	1915	1910
1906	574	574	0	1903	170	1934	
1907	1,160	1,160	0	1905	283	1915	
1908	1,739	1,739	0				

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	11,497	11,497	0	1910	1,128	1,128	0
1882	1,030	1,030	0	1911	3,341	3,341	0
1883	678	678	0	1912	1,859	1,859	0
1891	2,479	2,479	0	1913	1,046	1,046	0
1892	994	994	0	1914	847	847	0
1893	1,056	1,056	0	1915	1,676	1,676	0
1894	2,035	2,035	0	1916	1,506	1,506	0
1895	1,514	1,514	0	1917	246	246	0
1896	1,289	1,289	0	1918	23	23	0
1897	1,602	1,602	0	1921	35	35	0
1898	159	159	0	1922	715	715	0
1900	313	313	0	1926	20	20	0
1901	363	363	0	1940	0	0	0
1902	1,042	818	224				
1903	776	776	0	TOTAL	46,122	45,898	224
1904	1,202	1,202	0				
1905	180	180	0	<i>Retirements by Years</i>			
1906	1,789	1,789	0	<i>Year</i>			
1907	1,595	1,595	0	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1908	1,311	1,311	0	1902	224	1936	
1909	776	776	0				

8-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	6,054	6,054	0
1884	900	900	0
1889	692	692	0
1892	507	507	0
1904	542	542	0
1910	352	352	0
1912	285	285	0
1940	0	0	0
TOTAL	9,332	9,332	0

10-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	5,280	5,280	0
1893	1,507	1,507	0
1894	867	867	0
1914	553	553	0
1940	0	0	0
TOTAL	8,207	8,207	0

12-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	8,103	6,398	1,705
1904	6,100	6,088	12
1905	16	16	0
1940	0	0	0
TOTAL	14,219	12,502	1,717

Retirements by Years

Year	Feet		Year	Feet	
<i>Installed</i>	<i>Feet</i>		<i>Year</i>	<i>Feet</i>	<i>Year</i>
1881	230		1936	1,475	1938
1904	12		1938		

14-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1902	7,002	7,002	0
1940	0	0	0
TOTAL	7,002	7,002	0

16-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1902	1,512	1,512	0
1905	94	94	0
1913	128	128	0
1940	0	0	0
TOTAL	1,734	1,734	0

18-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1902	784	784	0
1940	0	0	0
TOTAL	784	784	0

4-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	30	30	0
1934	173	173	0
1940	0	0	0
TOTAL	203	203	0

6-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	824	824	0
1931	155	155	0
1936	396	396	0
1937	218	218	0
1938	167	167	0
1939	800	800	0
1940	0	0	0
TOTAL	2,560	2,560	0

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1936	307	307	0
1937	994	994	0
1940	0	0	0
TOTAL	1,301	1,301	0

SURVIVAL AND RETIREMENT

12-IN. CAST-IRON CEMENT-LINED MAINS				12-IN. WROUGHT-IRON MAINS			
Year	Feet			Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	1,514	1,514	0	1936	137	137	0
1940	0	0	0	1940	0	0	0
TOTAL	1,514	1,514	0	TOTAL	137	137	0

VALVES

4-IN. VALVES

Year	Number			Year	Number		
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1881	20	16	4	1910	1	1	0
1883	2	2	0	1911	1	1	0
1884	1	1	0	1912	7	7	0
1885	1	1	0	1916	1	1	0
1886	1	1	0	1918	1	1	0
1891	9	9	0	1922	2	2	0
1892	8	8	0	1923	1	1	0
1893	11	11	0	1924	2	2	0
1894	13	13	0	1925	2	2	0
1895	4	4	0	1930	2	2	0
1896	1	1	0	1939	1	1	0
1897	4	3	1	1940	0	0	0
1901	2	2	0				
1902	3	3	0	TOTAL	122	117	5
1903	4	4	0				
1904	3	3	0				
1905	3	3	0				
1906	2	2	0				
1907	4	4	0				
1908	5	5	0				

Retirements by Years						
Year	Num-	Year	Num-	Year	Num-	Year
Installed	ber	Year	ber	Year	ber	Year
1881	2	1893	1	1904	1	1922
1897	1	1909				

6-IN. VALVES

Year	Number			Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	20	20	0	1898	1	1	0
1882	3	3	0	1900	3	3	0
1883	1	1	0	1901	1	1	0
1891	3	3	0	1902	2	2	0
1892	2	2	0	1904	4	4	0
1893	1	1	0	1906	5	5	0
1894	3	3	0	1907	1	1	0
1895	3	3	0	1908	2	2	0
1896	1	1	0	1909	2	2	0
1897	2	2	0	1910	3	3	0

6-IN. VALVES (contd.)

<i>Year</i> <i>Installed</i>	<i>Number</i>			<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1911	7	7	0	1930	2	2	0
1912	7	7	0	1931	1	1	0
1913	3	3	0	1937	1	1	0
1914	2	2	0	1939	3	3	0
1915	5	5	0	1940	0	0	0
1916	5	5	0		—	—	—
1917	1	1	0	TOTAL	101	101	0
1921	1	1	0				

8-IN. VALVES

<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	8	8	0
1889	1	1	0
1891	2	2	0
1904	1	1	0
1910	2	2	0
1912	1	1	0
1936	1	1	0
1940	0	0	0
	—	—	—
TOTAL	16	16	0

10-IN. VALVES

<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	4	4	0
1893	2	2	0
1904	2	2	0
1913	1	1	0
1914	1	1	0
1923	1	1	0
1940	0	0	0
	—	—	—
TOTAL	11	11	0

12-IN. VALVES

<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	4	3	1
1904	4	4	0
1905	3	3	0
1911	1	1	0
1913	3	3	0

12-IN. VALVES (contd.)

<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1936	2	2	0
1938	5	5	0
1940	1	1	0
	—	—	—
TOTAL	23	22	1

Retirements by Years

<i>Year</i> <i>Installed</i>	<i>Number</i>	<i>Year</i>
1881	1	1938

14-IN. VALVES

<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1902	2	1	1
1940	0	0	0
	—	—	—
TOTAL	2	1	1

Retirements by Years

<i>Year</i> <i>Installed</i>	<i>Number</i>	<i>Year</i>
1902	1	1940

16-IN. VALVES

<i>Year</i> <i>Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1902	1	1	0
1913	1	1	0
1940	0	0	0
	—	—	—
TOTAL	2	2	0

HYDRANTS

4- AND 5-IN. HYDRANTS

<i>Year</i>				<i>Year</i>			
<i>Number</i>				<i>Number</i>			
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1881	12	0	12	1918	9	7	2
1882	5	0	5	1919	26	26	0
1883	4	1	3	1920	4	4	0
1884	1	1	0	1921	2	2	0
1889	2	0	2	1922	11	11	0
1891	4	0	4	1923	1	1	0
1892	1	1	0	1925	2	2	0
1893	2	1	1	1928	3	3	0
1894	2	0	2	1929	4	4	0
1895	1	0	1	1930	6	6	0
1896	2	0	2	1931	3	3	0
1897	9	2	7	1932	4	4	0
1904	2	0	2	1933	1	1	0
1906	3	2	1	1934	3	3	0
1907	1	0	1	1935	1	1	0
1909	1	0	1	1936	1	1	0
1910	2	0	2	1937	2	2	0
1911	1	0	1	1938	4	4	0
1912	7	6	1	1939	3	3	0
1913	2	2	0	1940	1	1	0
1915	4	2	2				
1916	7	6	1				
1917	1	1	0				
				TOTAL	167	114	53

Retirements by Years

<i>Year</i>	<i>Num-</i>		<i>Num-</i>		<i>Num-</i>		<i>Year</i>	<i>Num-</i>		<i>Num-</i>		<i>Num-</i>	
<i>Installed</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>	<i>Installed</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>
1881	2	1912	1	1916	4	1922	1897	2	1912	3	1922	1	1929
	2	1925	1	1932	1	1934		1	1931				
	1	1935					1904	1	1916	1	1928		
1882	1	1917	1	1921	2	1932	1906	1	1915				
	1	1933					1907	1	1932				
1883	1	1912	1	1918	1	1929	1909	1	1922				
1889	1	1918	1	1923			1910	1	1930	1	1938		
1891	1	1912	2	1922	1	1930	1911	1	1921				
1893	1	1915					1912	1	1931				
1894	1	1920	1	1930			1915	1	1928	1	1938		
1895	1	1930					1916	1	1939				
1896	1	1922	1	1940			1918	1	1928	1	1938		

Ottawa, Ontario

As of December 31, 1940

THE Ottawa Water Works system is a municipal plant serving the city of Ottawa in the Province of Ontario, Canada; the adjacent municipalities of Eastview and Rockcliffe; and portions of Nepean and Gloucester Townships.

Ottawa is chiefly important as the capital city of the Dominion. Within the city there were, as of the date of the study, 30,234 consumers and in the adjacent communities 2,224, or a total of 32,458 consumers, corresponding to an estimated population of about 165,116 served by the system. Consumption averaged 18.5 mgd. (Imp.) in 1940, or about 111.8 gpd. per capita. (Imperial gallons are used throughout this report. One gallon (Imp.) is equal to 1.201 gal. (U.S.).)

Industrial activity is not prominent in Ottawa. The Parliament buildings are located there and it is the center of many governmental agencies, which are reflected by a high type of residential development within and adjacent to the city.

Development of the Existing System

The Ottawa Water Works was founded in the year 1872, as a result of negotiations carried on by the Corporation and the Dominion Government from 1869 to 1872. In 1872 certain rights to use water from the Ottawa River for water supply and power purposes were granted by the Dominion Government.

Construction of the original Queen Street Pumping Station, Aqueduct No. 1 and the distribution system was started in 1873. The supply has always been secured from the Ottawa River, which provides an abundant and excellent source of soft water. Until 1913 all pumping was done by hydraulic power and more than 25 per cent of the high-lift pumping is still done by water power.

In the period of original construction, 1873-1876, the Queen Street Pumping Station, including pumping unit Nos. 1, 2 and 3; Aqueduct No. 1; and a 30-in. wood stave supply line were built. In 1890 the wood stave line was replaced by a 40-in. steel pipeline and extended to near Lemieux Island, 2 mi. upstream; the Queen Street Station was enlarged and No. 4 pumping unit installed. Further extensions were made in 1899-1900 to house pumping unit Nos. 5, 6, 7 and 8.

During the period 1907-1912, Aqueduct No. 2 and a new 42-in. steel pipe supply line were built. In 1913, electric low-lift pumping was started in a station constructed at Lemieux Island. Also in this year additional fire pressure, utilized only when necessary, was provided in the congested business area. Several additions to the pumping and transmission works were constructed in 1915, 1916, 1917 and 1922.

In 1929-1932, the Lemieux Island Purification Plant was constructed to

TABLE 1
SUMMARY OF MAINS—OTTAWA, ONTARIO

Size, in.	Kind	No. of Feet Installed	Percentage of Total	No. of Feet Retired	Percentage of Total	No. of Feet in Service	Percentage of Total	Year of First Installation	Average Age, yr.
51	Steel	18,890	1.66	0	0.00	18,890	1.75	1918	21.7
48	Concrete	2,433	0.21	0	0.00	2,433	0.22	1937	3.5
42	Steel	5,450	0.48	3,050	5.22	2,400	0.22	1912	28.5
40	Steel	6,006	0.53	0	0.00	6,006	0.56	1890	50.5
36	Cast-iron unlined	6,853	0.61	0	0.00	6,853	0.63	1916	24.3
30		2,046	0.18	0	0.00	2,046	0.19	1916	24.2
24		12,747	1.12	0	0.00	12,747	1.18	1890	30.2
20		5,235	0.46	0	0.00	5,235	0.48	1916	20.2
18		8,924	0.78	0	0.00	8,924	0.83	1915	24.8
16		37,166	3.26	0	0.00	37,166	3.44	1912	15.3
15		30,476	2.67	144	0.25	30,332	2.80	1874	52.6
12		80,221	7.04	550	0.94	79,671	7.37	1874	35.8
10		10,865	0.95	0	0.00	10,865	1.00	1908	27.5
8		126,102	11.06	560	0.96	125,542	11.61	1874	37.7
6		360,631	31.64	4,328	7.40	356,303	32.95	1875	25.3
5		337,292	29.59	27,831	47.58	309,461	28.62	1874	53.8
4		42,449	3.72	3,392	5.80	39,057	3.61	1884	38.4
3		46,075	4.04	18,628	31.85	27,447	2.54	1874	50.7
TOTAL		1,139,861	100.00	58,483	100.00	1,081,378	100.00		37.3
Percentage of Total		100.00		5.13		94.87			
Average Size, in.		8.53		6.42		8.64			

Mortality Survival Ratios

Size, in.	Kind	No. of Feet	Period Covered, yr.	Percentage
3-5	Cast-iron unlined	425,816	66.5	80.557
6		360,631	65.5	74.520
8		126,102	66.5	98.220
10 and 12		91,086	66.5	99.081
Over 12		103,447	66.5	99.561
40-51	Steel	30,346	50.5	73.376
48	Concrete	2,433	3.5	100.000
TOTAL		1,139,861		

provide full purification treatment of the supply. This is a modern, rapid sand filtration plant of substantial and attractive construction, providing chemical storage and feeding, mixing,

settling, filtration and chlorination and the necessary low- and high-lift pumping plants. There are ten filter units of 3.5-mgd. rated capacity each. When the purification plant was placed in

TABLE 2
SUMMARY OF METERS—OTTAWA, ONTARIO

Size, in.	Kind	Number Purchased	Number Sold or Returned to Factory	Number Installed	Number Retired	Number in Service	Average Age yr.
$\frac{3}{8}$	Rotary	1	0	1	1	0	0
$\frac{1}{2}$		7	0	7	0	7	10.5
$\frac{5}{8}$		433	35	398	31	367	20.7
$\frac{3}{4}$		151	15	136	3	133	18.0
1		58	3	55	0	55	19.1
$1\frac{1}{4}$		3	1	2	0	2	8.5
$1\frac{1}{2}$		15	3	12	2	10	15.2
2		28	11	17	0	17	23.7
3		14	2	12	1	11	21.0
4		2	0	2	1	1	25.5
6	Disc	3	0	3	0	3	25.5
$\frac{5}{8}$		1,008	73	935	42	893	14.1
$\frac{3}{4}$		539	138	401	9	392	12.2
1		324	39	285	16	269	16.7
$1\frac{1}{4}$		18	4	14	1	13	17.8
$1\frac{1}{2}$		124	11	113	1	112	11.9
2		221	7	214	2	212	20.8
3		33	0	33	1	32	11.8
$1\frac{1}{2}$		3	1	2	0	2	26.5
2		55	3	52	16	36	21.7
3	Current	41	4	37	4	33	24.8
4		36	1	35	2	33	23.7
6		20	0	20	0	20	22.5
8		4	0	4	0	4	21.0
$1\frac{1}{2}$		1	0	1	0	1	21.5
2	Compound	25	0	25	0	25	19.7
3		31	0	31	0	31	19.0
4		22	0	22	0	22	18.4
6		28	4	24	0	24	17.7
8		17	7	10	0	10	16.2
TOTAL		3,265	362	2,903	133	2,770	17.6

Mortality Survival Ratios

Size, in.	Kind	Number	Period Covered, yr.	Percentage
$\frac{5}{8}$	Rotary	398	25.5	90.344
$\frac{5}{8}$	Disc	935	39.5	15.231
$\frac{3}{4}$ -6 (excl. $\frac{5}{8}$)	Rotary	247	25.5	94.352
$\frac{3}{4}$ -3	Disc	1,060	40.5	8.141
$1\frac{1}{2}$ -8	Compound	113	25.5	100.000
$1\frac{1}{2}$ -8	Current	150	31.5	30.016
TOTAL		2,903		

service the under-water portion of the 42-in. steel main was no longer used and, although still in place, was considered retired as of that date.

The transmission system consists of approximately 5.6 mi. of 40- to 51-in. steel and concrete pipelines from the Lemieux Island plant to the distribution system and to the Queen Street Pumping Station. There are in the distribution system approximately 200 mi. of cast-iron mains from 3 to 36 in. in diameter. The greater portion of the system consists of pit-cast, bell-and-spigot, Class C pipe. Formerly the pipe was laid with a 5-ft. minimum cover. Due to the routine of snow removal, freezing became a problem and mains are now generally laid with a 6.5-ft. cover.

There are approximately 30,000 services within the city, which, with the exception of the larger cast-iron services, are of lead. The system has 2,525 valves, 1,618 hydrants and 2,326 meters. With the exception of the larger buildings, commercial and manufacturing establishments, schools and government buildings, the domestic services are unmetered. Approximately 34.7 per cent of the total amount of water pumped in 1940 was used through service meters.

Basis of Study

The records of the system pertaining to distribution and transmission mains, services, meters and Class B facilities are complete from the date of construction or installation, beginning in 1872. Annual reports are available from 1874 to the present date, and additions to the system and retirements therefrom are stated to be complete.

The work of abstracting the records of installation and retirement of mains and meters and the compiling of the

data into the form prescribed for the use of the Committee on Survival and Retirement Experience With Water Works Facilities, was carried out by the regular staff of the department. While the records of service installations and retirements are complete, the immense amount of work required for abstracting and compiling the information required was beyond the ability of the existing force to do in the circumstances prevailing at the time the study was being made.

Mortality Survival Study

From the compilation of additions and retirements a mortality study was made of the transmission and distribution mains and meters. Table 1 is a summary of all of the pipe installed and retired as well as data relating to average ages, length of record, mortality survival ratio and average sizes. Figure 1 shows the mortality survival curves covering the entire record of the sizes of pipe shown.

Table 2 is a similar summary for meters and Fig. 2 shows the corresponding mortality survival curves. The department records include all meters which have been purchased and put into service. Many of the smaller meters were located on services outside the city limits. Upon investigation it was found that a substantial portion of these meters was sold to the consumer after installation. Generally it is stated that these meters are still in service, but the department has no record available as to what happens to them after their sale. These meters were, therefore, omitted from the installations in computing the mortality survival curves.

A summary of the basic data covering installations and retirements is appended hereto.

TABLE 3
CAUSES OF RETIREMENTS OF MAINS—OTTAWA, ONTARIO

Size in.	Kind	Length ft.	Life yr.	Cause of Retirement	Size in.	Kind	Length ft.	Life yr.	Cause of Retirement
42	Steel	3,050	20.5	Under-water crossing, not used after filter plant went into operation	5	Cast-iron	1,050	59.5	Street elimination
							250	34.5	Physical
							1,405	64.5	
							5,040	59.5	
							814	58.5	
15	Cast-iron	144	25.5	Civic center improvement			260	56.5	
							1,350	53.5	
12	Cast-iron	550	28.5	Superseded by construction of 48-in. concrete line			564	45.5	
							608	44.5	
							3,209	36.5	Inadequate
							500	35.5	
							480	34.5	
8	Cast-iron	60	46.5	Frost fracture			1,780	31.5	
		500	41.5	Bolted under-water crossing, bolt corrosion			1,500	29.5	
							516	25.5	
							2,466	19.5	
							800	14.5	
6	Cast-iron	384	47.5				550	65.5	
		192	45.5				126	30.5	Unknown
		636	39.5				36	29.5	
		540	34.5	Frost fracture	4	Cast-iron	416	40.5	
		475	29.5				160	39.5	Frost fracture
		380	21.5				256	16.5	
		1,100	20.5				697	21.5	
		300	58.5	Leakage, under 30-ft. fill			200	15.5	
							400	13.5	Inadequate
		200	41.5	Civic center improvement			639	10.5	
		121	12.5	Inadequate			624	8.5	
5	Cast-iron	176	48.5		3	Cast-iron	129	37.5	Frost fracture
		64	44.5				2,700	58.5	
		76	43.5				499	41.5	
		228	37.5				1,291	36.5	
		300	34.5	Frost fracture			2,871	35.5	Inadequate
		75	33.5				2,629	34.5	
		1,200	28.5				2,513	20.5	
		104	27.5				1,752	19.5	
		401	23.5				1,062	13.5	
		803	21.5				1,486	56.5	
		1,100	62.5	Street elimination			475	55.5	Unknown
							700	34.5	
							521	22.5	

Causes of Retirements

The records of the department contain substantially all the reasons why mains and meters were retired. Table 3 gives a summary by sizes of the

causes of retirements of mains. Of the total retirements of water mains, approximately 72.4 per cent were caused by inadequacy, 5.2 per cent were ordered by public authorities, 13.9 per

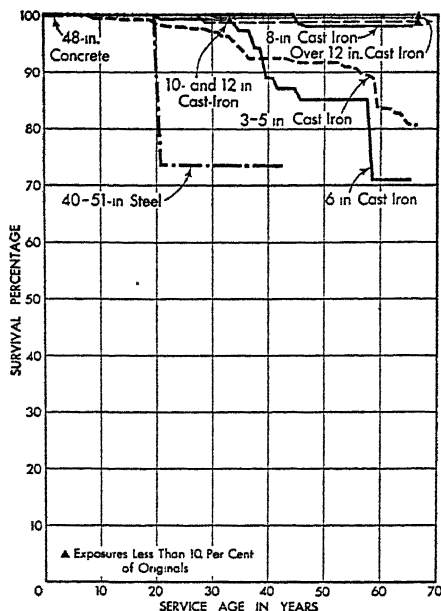


FIG. 1. Mortality Survival Curve—3-51-in. Mains—Ottawa, Ontario

BASE: Feet		SURVIVAL: 1874-1940	
SIZE in.	KIND	EXPO- SURES ft.	RETIRE- MENTS ft.
3-5	Cast-iron	425,816	49,851
6		360,631	4,328
8		126,102	560
10 and 12		91,086	550
Over 12	Steel	103,447	144
40-51		30,346	3,050
48		2,433	0

cent resulted from freezing and 8.5 per cent were caused by other factors, including 6.7 per cent which could not be definitely determined from the records.

Tuberculation and corrosion are not serious problems with the mains in Ottawa. Inadequacy has been the main cause of retirements since the early system contained a preponderant part of 3-, 4- and 5-in. pipe which have had to be replaced with larger sizes.

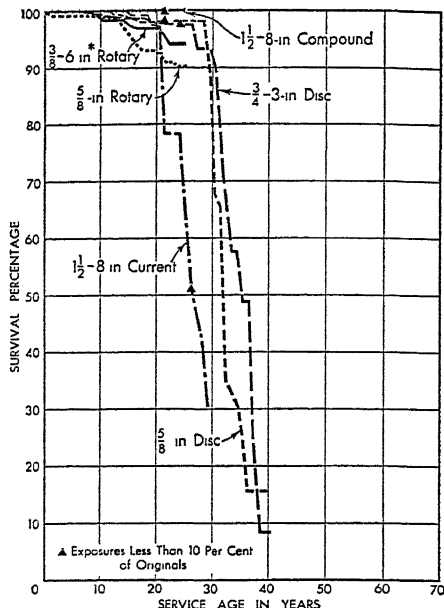


FIG. 2. Mortality Survival Curve—3-8-in. Meters—Ottawa, Ontario

BASE: Unit		SURVIVAL: 1901-1940	
SIZE in.	KIND	EXPO- SURES Units	RETIRE- MENTS Units
3-6 in	Disc	935	42
5-8 in	Rotary	398	31
1-2-8	Disc	1,060	30
* 3-6	Rotary	247	8
1-2-8	Compound	113	0
1-2-8	Current	150	22

* Excluding 3-8-in.

Snow removal, resulting in deeper penetration of frost, has caused considerable trouble from freezing and breaking in the older pipe, which had less cover than is now being provided.

The causes of the retirements of meters are shown in Table 4. As may be noted, 88 per cent were caused by physical wear and tear, 7 per cent were stolen and approximately 5 per cent were retired because of freezing and the damage caused thereby.

TABLE 4
CAUSES OF RETIREMENTS OF METERS—OTTAWA, ONTARIO

Size in.	Kind	Num- ber	Life yr.	Cause of Retirement	Size in.	Kind	Num- ber	Life yr.	Cause of Retirement
$\frac{3}{8}$	Rotary	1	22.5	Frozen	$\frac{3}{4}$	Disc	1	35.5	Stolen
$\frac{5}{8}$	Rotary	3	21.5	Stolen			1	8.5	Stolen
		1	13.5				1	37.5	
		1	11.5				1	35.5	
		1	21.5				2	33.5	Wear and tear
		3	20.5				1	30.5	
		3	17.5				2	13.5	
		4	16.5	Wear and tear	1	Disc	2	38.5	Wear and tear
		5	15.5				2	37.5	
		4	14.5				1	33.5	
		4	13.5				2	32.5	
		1	8.5				3	31.5	
		1	7.5				2	27.5	
							1	18.5	
$\frac{3}{4}$	Rotary	1	16.5	Stolen			1	17.5	
		1	9.5	Lost in fire			1	14.5	
		1	23.5	Wear and tear			1	12.5	
$1\frac{1}{2}$	Rotary	2	5.5	Wear and tear	$1\frac{1}{4}$	Disc	1	14.5	Wear and tear
3	Rotary	1	10.5	Wear and tear	$1\frac{1}{2}$	Disc	1	19.5	Wear and tear
4	Rotary	1	10.5	Wear and tear	2	Disc	1	31.5	Wear and tear
$\frac{5}{8}$	Disc	1	15.5	Stolen			1	9.5	Frozen
		1	18.5	Frozen			1	6.5	Frozen
		1	13.5	Frozen	3	Disc	1	7.5	Frozen
		3	37.5	Wear and tear	2	Current	2	26.5	Wear and tear
		2	36.5				2	25.5	
		1	35.5				11	21.5	
		1	34.5				1	19.5	
		13	33.5						
		1	32.5		3	Current	1	28.5	Wear and tear
		9	31.5				1	27.5	
		4	30.5				2	25.5	
		1	17.5		4	Current	1	29.5	Wear and tear
		1	16.5						
		3	13.5						

Acknowledgments

The collection and compilation of data in Ottawa were under the general supervision of W. E. MacDonald, City Water Works Engineer and a member of the Committee on Survival and Re-

tirement Experience With Water Works Facilities. Assisting him in this work were C. D. Wight, H. P. Stockwell, C. T. Heeney, H. R. Hooper, W. A. Featherston and personnel under their direction.

SUMMARY OF CLASS B FACILITIES

OTTAWA, ONTARIO

Purification Plant

Lemieux Island rapid sand filtration plant, rated 35-mgd. capacity, consisting of three spiral flow mixing chambers, three coagulating basins, ten 3.5-mgd. filter units, with clear well capacity of 6 mil.gal. Plant has low- and high-lift pumping stations. Constructed in 1932 of reinforced concrete with brick veneer and limestone trim and still in service

Pumping Stations

Lemieux Island high- and low-lift pumping stations are an integral part of the filtration plant.

Queen Street Pumping Station, where high-lift pumping is partially done, largely by water power, is the original station, constructed of stone masonry in 1873-1874. Several additions have been made since the original station was built.

*Pumping Equipment**Lemieux Island—Low-Lift*

Unit Nos. 1, 2 and 3—17.5-mgd. horizontal, centrifugal pumping units; 47.5-ft. head; driven by 200-hp. squirrel cage motors. Installed in 1932 (motors purchased in 1922); still in service.

Unit No. 4—35-mgd. horizontal centrifugal pumping unit; 47.5-ft. head; driven by 420-hp. diesel oil engine. Installed in 1932; still in service.

Lemieux Island—High-Lift

Unit Nos. 1 and 2—20-mgd. horizontal, double-stage centrifugal pumping units; 280-ft. head; driven by 1,600-hp. wound rotor induction motors. Installed in 1917; still in service.

Unit Nos. 3 and 4—17-mgd. horizontal, single-stage centrifugal pumping units; 210-ft. head; driven by 950-hp. synchronous motors. Installed in 1932 and 1934; still in service.

Wash water pumps, Nos. 1 and 2—5-mgd. horizontal, centrifugal pumping units; 40-ft. head; driven by 60-hp. squirrel cage motors. Installed in 1932; still in service.

Lemieux Island—River Low-Lift

Unit Nos. 1, 2, 3 and 4—12-mgd. roturbo units; 18-ft. head; belt driven by electric motors installed in 1913 to provide head on submarine pipeline because of typhoid epidemic. Very inefficient and units were retired in 1915 and placed in storage. Replaced by four horizontal, centrifugal pumping units; 18-ft. head; driven by 85-hp. squirrel cage motors. Installed: one in 1913, three in 1915; one retired in 1932 and three in 1940. Units held in storage.

Queen Street Pumping Station

Unit Nos. 1, 2 and 3—3-mgd. reciprocating pumping units against 150-lb. pressure driven by hydraulic turbines. Installed in 1874; still in service, but face early retirement.

Unit No. 4—10-mgd. reciprocating pumping unit driven by hydraulic turbine. Installed in 1890; retired 1934 at scrap value.

New Unit No. 4—17-mgd. centrifugal pumping unit, 210-ft. head, driven by 760-hp. hydraulic turbine. Installed in 1935; still in service.

Unit Nos. 5, 6, 7 and 8—8-mgd. reciprocating pumping units, double duplex; 110-lb. head; driven by 1,400-hp. hydraulic turbines. Installed in 1900 and 1908; still in service.

Unit Nos. 9 and 9a—12-mgd. centrifugal pumping units, two single stage; usable alone or in series; 225- to 270-ft. head; driven by 750- and 160-hp. wound rotor induction motors. Installed in 1915; still in service.

Slater Street Booster Station

Unit No. 1—2,000-gpm. roturbo-type pumping unit; 80-lb. head; driven by 165-hp. induction motor. Installed in 1913; retired 1940 due to fracture of pump casing, at scrap value.

New Unit No. 1—2,000-gpm. centrifugal pumping unit; 80-lb. head; driven by 150-hp. induction motor. Installed in 1940; still in service.

Unit No. 2—2,000-gpm. roturbo-type pumping unit; 80-lb. head; driven by 165-hp. induction motor. Installed in 1913; still in service.

Unit No. 3—2,000-gpm. roturbo-type pumping unit; 80-lb. head; driven by 175-hp. induction motor. Installed in 1916; still in service.

SURVIVAL AND RETIREMENT

4-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years

<i>Year</i>						<i>Year</i>							
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1886	697	1907					1896	639	1908				
1893	400	1909	64	1936			1908	624	1916				
1895	200	1910	160	1934	416	1935	1920	192	1936				

5-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1874	65,852	50,374	15,478	1897	9,901	9,901	0
1875	18,290	15,660	2,630	1898	5,711	5,711	0
1876	2,304	2,304	0	1899	6,228	6,000	228
1877	35,285	33,910	1,375	1900	1,414	1,414	0
1878	10,517	9,017	1,500	1901	3,251	3,251	0
1880	4,142	4,142	0	1902	2,860	2,860	0
1881	2,453	2,453	0	1903	5,311	5,311	0
1882	2,282	2,282	0	1904	1,983	1,983	0
1883	293	293	0	1905	456	456	0
1884	2,500	2,500	0	1906	3,047	3,047	0
1885	3,889	3,889	0	1907	2,996	1,176	1,820
1886	9,773	9,773	0	1908	7,470	6,508	962
1887	27,115	24,026	3,089	1909	1,441	1,441	0
1888	6,834	6,834	0	1910	1,836	1,836	0
1889	30,741	30,164	577	1911	477	477	0
1890	10,761	10,697	64	1912	252	252	0
1891	2,788	2,712	76	1913	128	96	32
1892	3,157	3,157	0	1914	1,140	1,140	0
1893	9,577	9,577	0	1918	440	440	0
1894	15,635	15,635	0	1930	700	700	0
1895	6,014	6,014	0	1940	0	0	0
1896	10,048	10,048	0				
				TOTAL	337,292	309,461	27,831

Retirements by Years

[illegible]

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i>				<i>Year</i>			
<i>Feet</i>				<i>Feet</i>			
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1875	1,780	1,480	300	1917	2,276	2,276	0
1877	200	0	200	1918	285	285	0
1887	700	700	0	1919	6,283	6,283	0
1889	4,788	4,408	380	1920	11,358	11,358	0
1890	192	0	192	1921	15,323	15,323	0
1892	1,506	966	540	1922	17,492	17,492	0
1894	684	300	384	1923	13,259	13,259	0
1896	121	0	121	1924	4,837	4,837	0
1898	636	0	636	1925	1,498	1,498	0
1899	655	655	0	1926	2,250	2,250	0
1900	1,457	1,457	0	1927	4,191	4,191	0
1901	36	36	0	1928	2,426	2,426	0
1902	560	560	0	1929	494	494	0
1903	744	744	0	1930	7,466	7,466	0
1904	2,064	2,064	0	1931	3,079	3,079	0
1905	3,399	3,399	0	1932	2,886	2,886	0
1906	8,698	8,698	0	1933	2,208	2,208	0
1907	6,825	6,665	160	1934	2,924	2,924	0
1908	63,534	62,434	1,100	1935	6,518	6,518	0
1909	28,920	28,920	0	1936	6,002	6,002	0
1910	24,860	24,545	315	1937	3,520	3,520	0
1911	22,835	22,835	0	1938	2,289	2,289	0
1912	15,238	15,238	0	1939	3,984	3,984	0
1913	16,849	16,849	0	1940	3,493	3,493	0
1914	15,278	15,278	0				
1915	8,147	8,147	0	TOTAL	360,631	356,303	4,328
1916	3,584	3,584	0				

Retirements by Years

<i>Year</i>			<i>Year</i>			<i>Year</i>		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1875	300	1933	1892	540	1926	1907	160	1936
1877	200	1918	1894	384	1931	1908	1,100	1928
1889	380	1910	1896	121	1908	1910	315	1939
1890	192	1935	1898	636	1937			

8-IN. CAST-IRON UNLINED MAINS

<i>Year</i>				<i>Year</i>			
<i>Feet</i>				<i>Feet</i>			
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1874	13,040	13,040	0	1895	912	912	0
1875	2,920	2,920	0	1896	8,941	8,941	0
1876	1,370	1,370	0	1897	6,134	6,134	0
1877	1,960	1,960	0	1899	2,060	2,060	0
1878	590	590	0	1902	45	45	0
1886	915	915	0	1903	6,500	6,500	0
1887	3,364	2,864	500	1904	4,314	4,314	0
1888	2,818	2,758	60	1906	1,528	1,528	0
1889	2,829	2,829	0	1907	2,392	2,392	0
1890	936	936	0	1908	23,348	23,348	0
1891	500	500	0	1909	6,156	6,156	0
1894	234	234	0	1910	4,957	4,957	0

SURVIVAL AND RETIREMENT

8-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Year</i> <i>Installed</i>	<i>Feet</i>			<i>Year</i> <i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1911	2,408	2,408	0	1933	2,826	2,826	0
1912	3,003	3,003	0	1936	2,982	2,982	0
1914	1,694	1,694	0	1938	996	996	0
1915	816	816	0	1939	2,203	2,203	0
1916	722	722	0	1940	0	0	0
1917	256	256	0				
1922	252	252	0	TOTAL	126,102	125,542	560
1923	3,150	3,150	0				
1925	288	288	0	<i>Retirements by Years</i>			
1926	800	800	0				
1927	288	288	0	<i>Year</i>			
1928	540	540	0	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1930	930	930	0	1887	500	1932	
1931	1,006	1,006	0	1888	60	1934	
1932	2,179	2,179	0				

10-IN. CAST-IRON UNLINED MAINS

<i>Year</i> <i>Installed</i>	<i>Feet</i>			<i>Year</i> <i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1908	7,110	7,110	0	1938	740	740	0
1915	1,289	1,289	0	1940	0	0	0
1920	942	942	0				
1922	40	40	0	TOTAL	10,865	10,865	0
1923	744	744	0				

12-IN. CAST-IRON UNLINED MAINS

<i>Year</i> <i>Installed</i>	<i>Feet</i>			<i>Year</i> <i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1874	8,490	8,490	0	1920	1,450	1,450	0
1875	4,850	4,850	0	1921	2,472	2,472	0
1889	6,307	6,307	0	1922	555	555	0
1890	1,974	1,974	0	1926	800	800	0
1895	1,563	1,563	0	1928	1,040	1,040	0
1896	521	521	0	1931	1,488	1,488	0
1897	6,112	6,112	0	1932	564	564	0
1903	1,792	1,792	0	1933	1,944	1,944	0
1904	252	252	0	1934	2,622	2,622	0
1906	4,211	4,211	0	1939	3,008	3,008	0
1907	2,719	2,719	0	1940	0	0	0
1908	3,560	3,010	550				
1909	540	540	0	TOTAL	80,221	79,671	550
1910	6,213	6,213	0				
1911	240	240	0	<i>Retirements by Years</i>			
1912	3,370	3,370	0				
1913	2,830	2,830	0	<i>Year</i>			
1915	6,696	6,696	0	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1916	1,138	1,138	0	1908	550	1936	
1919	900	900	0				

15-IN. CAST-IRON UNLINED MAINS

Year				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1874	5,460	5,460	0	1914	510	510	0
1875	7,770	7,770	0	1916	380	380	0
1888	4,248	4,248	0	1926	35	35	0
1890	222	222	0	1940	0	0	0
1895	2,394	2,394	0	TOTAL	30,476	30,332	144
1897	960	960	0	Retirements by Years			
1898	2,351	2,351	0	Year			
1903	3,195	3,195	0	Installed	Feet	Year	
1905	1,780	1,780	0	1909	144	1939	
1909	401	257	144				
1911	770	770	0				

16-IN. CAST-IRON UNLINED MAINS

Year				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1912	2,502	2,502	0	1890	170	170	0
1913	7,645	7,645	0	1906	2,874	2,874	0
1914	552	552	0	1907	961	961	0
1915	16,093	16,093	0	1912	8,402	8,402	0
1916	6,738	6,738	0	1913	192	192	0
1917	20	20	0	1916	4	4	0
1931	3,416	3,416	0	1939	144	144	0
1938	200	200	0	1940	0	0	0
1940	0	0	0	TOTAL	12,747	12,747	0
TOTAL	37,166	37,166	0				

24-IN. CAST-IRON UNLINED MAINS

Year				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1890	170	170	0	1916	1,476	1,476	0
1906	2,874	2,874	0	1917	570	570	0
1907	961	961	0	1940	0	0	0
1912	8,402	8,402	0	TOTAL	2,046	2,046	0
1913	192	192	0				
1916	4	4	0				
1939	144	144	0				
1940	0	0	0				
TOTAL	12,747	12,747	0				

18-IN. CAST-IRON UNLINED MAINS

Year				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1915	2,510	2,510	0	1916	6,414	6,414	0
1916	6,414	6,414	0	1940	0	0	0
1940	0	0	0	TOTAL	8,924	8,924	0
TOTAL	8,924	8,924	0				

30-IN. CAST-IRON UNLINED MAINS

Year				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1916	1,476	1,476	0	1916	5,741	5,741	0
1917	570	570	0	1917	1,112	1,112	0
1940	0	0	0	1940	0	0	0
TOTAL	2,046	2,046	0	TOTAL	6,853	6,853	0

20-IN. CAST-IRON UNLINED MAINS

Year				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1916	3,843	3,843	0	1916	5,741	5,741	0
1932	1,392	1,392	0	1917	1,112	1,112	0
1940	0	0	0	1940	0	0	0
TOTAL	5,235	5,235	0	TOTAL	6,853	6,853	0

36-IN. CAST-IRON UNLINED MAINS

Year				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1916	5,741	5,741	0	1916	5,741	5,741	0
1917	1,112	1,112	0	1917	1,112	1,112	0
1940	0	0	0	1940	0	0	0
TOTAL	6,853	6,853	0	TOTAL	6,853	6,853	0

40-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1890	6,006	6,006	0
1940	0	0	0
TOTAL	6,006	6,006	0

42-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	5,450	2,400	3,050
1940	0	0	0
TOTAL	5,450	2,400	3,050

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1912	3,050	1932

48-IN. STEEL CONCRETE-LINED AND COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1937	2,433	2,433	0
1940	0	0	0
TOTAL	2,433	2,433	0

51-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1918	15,700	15,700	0
1923	3,190	3,190	0
1940	0	0	0
TOTAL	18,890	18,890	0

METERS

 $\frac{3}{8}$ -IN. ROTARY METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1913	1	0	1
1940	0	0	0
TOTAL	1	0	1

Retirements by Years

Year	Number	Year
<i>Installed</i>		
1913	1	1935

 $\frac{1}{2}$ -IN. ROTARY METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	7	7	0
1940	0	0	0
TOTAL	7	7	0

 $\frac{5}{8}$ -IN. ROTARY METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1915	123	118	5
1918	25	25	0
1919	170	146	24
1921	1	1	0

 $\frac{3}{8}$ -IN. ROTARY METERS (contd.)

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	1	1	0
1926	49	48	1
1930	17	17	0
1932	7	7	0
1933	1	0	1
1936	1	1	0
1939	3	3	0
1940	0	0	0
SUBTOTAL	398	367	31
Unknown	35	0	35
TOTAL	433	367	66

Retirements by Years

Year	Num-	Year	Num-	Year	Num-
<i>Installed</i>	<i>ber</i>		<i>ber</i>		<i>ber</i>
1915	1	1926	3	1936	1
1919	4	1932	4	1933	5
	4	1935	3	1936	3
	1	1940			
1926	1	1934			
1933	1	1940			
Unknown 24—Sold, believed still in service.					
11—Returned to factory.					

$\frac{3}{4}$ -IN. ROTARY METERS

Year	Number		
Installed	Installed	In Service	Retired
1914	1	0	1
1915	21	21	0
1920	15	15	0
1923	9	9	0
1924	83	81	2
1930	4	4	0
1932	1	1	0
1936	2	2	0
1940	0	0	0
SUBTOTAL	136	133	3
Unknown	15	0	15
TOTAL	151	133	18

Retirements by Years

Year	Number	Year	Number	Year
Installed				
1914	1	1935		
1924	1	1933	1	1940
Unknown	14	Sold, believed still in service.		
	1	Returned to factory.		

1-IN. ROTARY METERS

Year	Number		
Installed	Installed	In Service	Retired
1915	17	17	0
1924	29	29	0
1925	9	9	0
1940	0	0	0
SUBTOTAL	55	55	0
Unknown	3	0	3
TOTAL	58	55	3

Retirements by Years

Unknown	3—Sold, believed still in service.
---------	------------------------------------

 $1\frac{1}{4}$ -IN. ROTARY METERS

Year	Number		
Installed	Installed	In Service	Retired
1932	2	2	0
1940	0	0	0
SUBTOTAL	2	2	0
Unknown	1	0	1
TOTAL	3	2	1

Retirements by Years

Unknown	1—Sold, believed still in service.
---------	------------------------------------

 $1\frac{1}{2}$ -IN. ROTARY METERS

Year	Number		
Installed	Installed	In Service	Retired
1915	1	1	0
1924	7	5	2
1925	1	1	0
1931	3	3	0
1940	0	0	0
SUBTOTAL	12	10	2
Unknown	3	0	3
TOTAL	15	10	5

Retirements by Years

Year	Number	Year
Installed		
1924	2	1939
Unknown	3—Sold, believed still in service.	

2-IN. ROTARY METERS

Year	Number		
Installed	Installed	In Service	Retired
1915	12	12	0
1921	5	5	0
1940	0	0	0
SUBTOTAL	17	17	0
Unknown	11	0	11
TOTAL	28	17	11

Retirements by Years

Unknown	11—Returned to factory.
---------	-------------------------

3-IN. ROTARY METERS

Year	Number		
Installed	Installed	In Service	Retired
1915	7	7	0
1919	1	0	1
1925	2	2	0
1930	2	2	0
1940	0	0	0
SUBTOTAL	12	11	1
Unknown	2	0	2
TOTAL	14	11	3

Retirements by Years

Year	Number	Year
Installed		
1919	1	1929
Unknown	2—Sold, believed still in service.	

SURVIVAL AND RETIREMENT

4-IN. ROTARY METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1915	1	1	0
1919	1	0	1
1940	0	0	0
TOTAL	2	1	1

Retirements by Years

Year	Number	Year
<i>Installed</i>		
1919	1	1929

6-IN. ROTARY METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1915	3	3	0
1940	0	0	0
TOTAL	3	3	0

 $\frac{5}{8}$ -IN. DISC METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1901	2	0	2
1902	32	5	27
1903	5	0	5
1906	3	3	0
1914	1	1	0
1916	1	0	1
1919	2	1	1
1921	100	96	4
1922	73	73	0
1923	98	97	1
1924	123	122	1
1925	99	99	0
1926	1	1	0
1927	52	52	0
1928	6	6	0
1929	4	4	0
1930	187	187	0
1932	98	98	0
1934	11	11	0
1935	25	25	0
1937	12	12	0
1940	0	0	0
SUBTOTAL	935	893	42
Unknown	73	0	73
TOTAL	1,008	893	115

 $\frac{5}{8}$ -IN. DISC METERS (contd.)

Retirements by Years

Year	Num-ber	Year	Num-ber	Year	Num-ber	Year
<i>Installed</i>						
1901	1	1933	1	1936		
1902	2	1932	9	1933	12	1935
	1	1936	3	1939		
1903	2	1933	1	1936	2	1939
1916	1	1933				
1919	1	1935				
1921	3	1934	1	1939		
1923	1	1936				
1924	1	1939				

Unknown 73—Sold, believed still in service.

 $\frac{3}{4}$ -IN. DISC METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1901	2	1	1
1902	2	0	2
1903	4	0	4
1918	32	32	0
1921	2	0	2
1922	21	21	0
1923	18	18	0
1925	120	120	0
1927	2	2	0
1928	3	3	0
1930	33	33	0
1931	9	9	0
1932	89	89	0
1936	9	9	0
1937	26	26	0
1938	10	10	0
1939	17	17	0
1940	2	2	0
SUBTOTAL	401	392	9
Unknown	138	0	138
TOTAL	539	392	147

Retirements by Years

Year	Num-ber	Year	Num-ber	Year	Num-ber	Year
<i>Installed</i>						
1901	1	1936				
1902	1	1935	1	1939		
1903	1	1911	1	1933	1	1936
	1	1938				
1921	2	1934				

Unknown 138—Sold, believed still in service.

1-IN. DISC METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1901	3	0	3
1902	7	0	7
1905	2	2	0
1906	5	3	2
1911	2	2	0
1912	2	2	0
1914	4	4	0
1915	1	1	0
1918	33	31	2
1919	20	20	0
1921	24	23	1
1922	21	21	0
1923	23	23	0
1924	25	24	1
1925	30	30	0
1927	16	16	0
1928	2	2	0
1930	18	18	0
1932	47	47	0
1940	0	0	0
<hr/>			
SUBTOTAL	285	269	16
Unknown	39	0	39
<hr/>			
TOTAL	324	269	55

Retirements by Years

<i>Year</i>	<i>Num-</i>		<i>Num-</i>		<i>Num-</i>	
<i>Installed</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>
1901	1	1933	2	1939		
1902	3	1933	1	1934	1	1935
	2	1939				
1906	2	1933				
1918	1	1935	1	1936		
1921	1	1935				
1924	1	1935				

Unknown 39—Sold, believed still in service.

1½-IN. DISC METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1919	10	9	1
1930	2	2	0
1932	2	2	0
1940	0	0	0
<hr/>			
SUBTOTAL	14	13	1
Unknown	4	0	4
<hr/>			
TOTAL	18	13	5

1¼-IN. DISC METERS (contd.)

Retirements by Years

<i>Year</i>	<i>Number</i>	<i>Year</i>
<i>Installed</i>		
1919	1	1933
Unknown 4—Sold, believed still in service.		

1½-IN. DISC METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1908	1	1	0
1909	1	0	1
1918	5	5	0
1919	12	12	0
1922	13	13	0
1923	8	8	0
1924	1	1	0
1925	7	7	0
1929	4	4	0
1930	9	9	0
1931	3	3	0
1902	23	23	0
1936	3	3	0
1937	3	3	0
1938	11	11	0
1939	3	3	0
1940	6	6	0
<hr/>			
SUBTOTAL	113	112	1
Unknown	11	0	11
<hr/>			
TOTAL	124	112	12

Retirements by Years

<i>Year</i>	<i>Number</i>	<i>Year</i>
<i>Installed</i>		
1909	1	1928
Unknown 11—Sold, believed still in service.		

2-IN. DISC METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1901	1	0	1
1908	1	1	0
1909	2	2	0
1912	3	3	0
1918	10	10	0
1922	32	32	0
1923	20	20	0
1924	50	50	0
1925	22	22	0
1927	14	14	0
1930	12	11	1

2-IN. DISC METERS (contd.)

Year	Number		
Installed	Installed	In Service	Retired
1932	47	47	0
1940	0	0	0
	—	—	—
SUBTOTAL	214	212	2
Unknown	7	0	7
	—	—	—
TOTAL	221	212	9

Retirements by Years

Year	Number	Year
Installed		
1901	1	1932
1930	1	1936
Unknown	7—Sold, believed still in service.	

3-IN. DISC METERS

Year	Number		
Installed	Installed	In Service	Retired
1924	6	6	0
1925	8	8	0
1927	6	5	1
1930	3	3	0
1933	1	1	0
1934	4	4	0
1935	1	1	0
1936	3	3	0
1937	1	1	0
1940	0	0	0
	—	—	—
TOTAL	33	32	1

Retirements by Years

Year	Number	Year
Installed		
1927	1	1934

1½-IN. COMPOUND METERS

Year	Number		
Installed	Installed	In Service	Retired
1919	1	1	0
1940	0	0	0
	—	—	—
TOTAL	1	1	0

2-IN. COMPOUND METERS

Year	Number		
Installed	Installed	In Service	Retired
1919	1	1	0
1921	24	24	0
1940	0	0	0
	—	—	—
TOTAL	25	25	0

3-IN. COMPOUND METERS

Year	Number		
Installed	Installed	In Service	Retired
1919	1	1	0
1920	1	1	0
1921	17	17	0
1922	6	6	0
1923	6	6	0
1940	0	0	0
	—	—	—
TOTAL	31	31	0

4-IN. COMPOUND METERS

Year	Number		
Installed	Installed	In Service	Retired
1915	3	3	0
1921	6	6	0
1922	4	4	0
1923	4	4	0
1927	5	5	0
1940	0	0	0
	—	—	—
TOTAL	22	22	0

6-IN. COMPOUND METERS

Year	Number		
Installed	Installed	In Service	Retired
1915	3	3	0
1918	2	2	0
1920	4	4	0
1922	2	2	0
1923	4	4	0
1924	2	2	0
1927	3	3	0
1930	4	4	0
1940	0	0	0
	—	—	—
SUBTOTAL	24	24	0
Unknown	4	0	4
	—	—	—
TOTAL	28	24	4

Retirements by Years

Year	Number	Year
Installed		
Unknown	4—Sold, believed still in service.	

8-IN. COMPOUND METERS

Year	Number		
Installed	Installed	In Service	Retired
1915	1	1	0
1918	1	1	0
1920	1	1	0
1922	1	1	0
1924	2	2	0
1927	2	2	0
1932	2	2	0
1940	0	0	0
	—	—	—
SUBTOTAL	10	10	0
Unknown	7	0	7
	—	—	—
TOTAL	17	10	7

Retirements by Years

Year	Number	Year
Installed		
Unknown	7—Sold, believed still in service.	

1½-IN. CURRENT METERS

Year	Number		
Installed	Installed	In Service	Retired
1914	2	2	0
1940	0	0	0
	—	—	—
SUBTOTAL	2	2	0
Unknown	1	0	1
	—	—	—
TOTAL	3	2	1

Retirements by Years

Year	Number	Year
Installed		
Unknown	1—Sold, believed still in service.	

2-IN. CURRENT METERS

Year	Number		
Installed	Installed	In Service	Retired
1907	2	0	2
1909	2	0	2
1911	2	0	2
1912	9	0	9
1914	7	6	1
1919	4	4	0

2-IN. CURRENT METERS (contd.)

Year	Number		
Installed	Installed	In Service	Retired
1920	26	26	0
1940	0	0	0
	—	—	—
SUBTOTAL	52	36	16
Unknown	3	0	3
	—	—	—
TOTAL	55	36	19

Retirements by Years

Year	Number	Year
Installed		
1907	2	1932
1909	2	1935
1911	2	1932
1912	9	1933
1914	1	1933
Unknown	3—Sold, believed still in service.	

3-IN. CURRENT METERS

Year	Number		
Installed	Installed	In Service	Retired
1905	3	1	2
1907	3	1	2
1908	1	1	0
1910	2	2	0
1911	2	2	0
1912	6	6	0
1918	7	7	0
1919	7	7	0
1920	5	5	0
1925	1	1	0
1940	0	0	0
	—	—	—
SUBTOTAL	37	33	4
Unknown	4	0	4
	—	—	—
TOTAL	41	33	8

Retirements by Years

Year	Number	Year	Number	Year
Installed				
1905	1	1932	1	1933
1907	2	1932		
Unknown	4—Sold, believed still in service.			

SURVIVAL AND RETIREMENT

4-IN. CURRENT METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1904	1	1	0
1905	1	0	1
1907	2	2	0
1911	2	2	0
1912	5	5	0
1915	1	0	1
1918	2	2	0
1919	1	1	0
1920	20	20	0
1940	0	0	0
	—	—	—
SUBTOTAL	35	33	2
Unknown	1	0	1
	—	—	—
TOTAL	36	33	3

Retirements by Years

<i>Year</i>		
<i>Installed</i>	<i>Number</i>	<i>Year</i>
1905	1	1934
1915	1	1930
Unknown	1—Sold, believed still in service.	

6-IN. CURRENT METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1906	1	1	0
1911	4	4	0
1919	2	2	0
1920	10	10	0
1924	3	3	0
1940	0	0	0
	—	—	—
TOTAL	20	20	0

8-IN. CURRENT METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1919	2	2	0
1920	2	2	0
1940	0	0	0
	—	—	—
TOTAL	4	4	0

Philadelphia, Pennsylvania

As of December 31, 1940

THE water supply of the city of Philadelphia, Pa., is provided by the municipally-owned works which represents one of the oldest water works systems in the United States. The municipal system functions as the Bureau of Water under the control of the Department of Public Works. It supplies all but a very small section of the entire occupied area of the city.

Philadelphia, the third city in size in the United States, with a population of 1,931,334 in 1940, is located in the southeastern part of Pennsylvania just above the confluence of the Schuylkill River with the Delaware River. The Schuylkill River flows through the western section of the city dividing it into two unequal areas. From early Colonial days the city has ranked among the first cities of the country. Besides being historically famous, the city ranks as an important commercial and manufacturing center, with its foundry, rolling mill and machine shop products, carpets, hats, street railway cars, knit goods and woolen goods. Shipbuilding in and around Philadelphia is also an important industry. The city covers an area of about 130 sq.mi., with ranges of elevation from tide water to 150 ft. above.

No detailed survey of the history and development of the existing water works system has been made. Water works were first developed prior to 1800. Parts of the present distribution system date from 1817, when the

first cast-iron pipe was installed. An outline of the present system follows.

General Outline of the System

The Delaware and Schuylkill rivers furnish the city an adequate supply of water. This is filtered and pumped to the distribution system which is separated into nine services inter-connected but valved off at points of separation. In 1940 the draft from the two river sources was approximately 350 mgd., of which slightly more than 50 per cent was pumped from the Delaware River at its main station, Torresdale. The average daily use is approximately 160 gal. per capita. About 45 per cent of the 460,000 services are metered.

There are thirteen pumping stations, eleven of which are electrically operated and two of which are operated by steam. The main supply is secured at the Torresdale Station where it is filtered and repumped at Lardners Point and Torresdale high-service pumping stations. From the Schuylkill River, the supply is pumped at three high-lift stations, Queen Lane, Shawmont and Belmont, to sedimentation reservoirs from which it is delivered to filters. The Shawmont supply is delivered by low-lift pumping to Upper Roxborough filters and to filtered water basins which deliver by gravity to four services. To two higher services the supply is furnished by repumping and from one of these it is again pumped to a higher service.

The Torresdale plant, generally serving over half of the total consumption, has a rated capacity of 220 mgd. The Queen Lane plant has a capacity of 100 mgd., the Upper Roxborough 25 mgd., Lower Roxborough, in reserve, 10 mgd. and the Belmont filters a capacity of 70 mgd.

Pressures maintained are generally low, ranging from 25 to 50 psi. in the main service, with only a few sections outside of this service having more than 50 psi.

The distribution system consists of approximately 2,500 mi. of pipe, of which all are cast iron except about 40 mi. of steel mains 24 in. in diameter and larger. Cast-iron pipe was first installed in 1817. Early installations were uncoated, but since about 1860 all pipe laid has been tar coated. No cement-lined pipe has been installed.

Basis of Study

The records of distribution and transmission mains are maintained in card index files which were started about 1877. At or about that date an exhaustive study was made of the cast-iron pipe laid and retired prior to that time, and this formed the basis of the present card index records. Information pertaining to the date of installation and the date of retirement is definite for the greater part of the pipe system. Pipe installed prior to 1875, which could not be identified in the records as being installed or retired in a particular year, could in many instances be rather definitely assigned dates, as is later described.

Approximately seven man-months were entailed in canvassing the card index record, checking and compiling the list of mains installed and retired.

In the case of certain of the early main installations of 3- to 12-in. pipe,

dates of installation and dates of retirement were assigned by the co-ordinator after a careful check of the records of each street. By comparison with intersecting streets and extensions and replacements of mains on the street having an undated pipe installation, a very close approximation could be made of the date of installation or retirement where such were lacking. The amount of such pipe is shown in Table 3.

Mortality Survival Study

From the compilation of installations and retirements a mortality study was made of the transmission and distribution mains. Table 1 is a summary of the pipe installed and retired and that remaining in service, as well as other pertinent data. Figure 1 shows the mortality survival curves covering the entire record of the pipe.

Causes of Retirement

The records of the department contain a substantially complete record of all pipe retired and information as to whether such pipe was abandoned in place or taken up. In many cases the record also indicates the reasons for the retirements. A full summary of the causes of retirement, as taken from the department records, is shown in Table 2. It is impossible that present officials could know what was done with pipe taken up in the period preceding their connection with the department. Pipe taken up which is in good condition is now generally reinstalled in other locations.

Subway construction and other public authority construction programs have been causes of considerable retirement of pipe and generally such removals have been salvaged and sold as scrap or re-used.

TABLE 1
SUMMARY OF MAINS
PHILADELPHIA, PENNSYLVANIA

Size, <i>in.</i>	Kind	No. of Feet Installed	Percentage of Total	No. of Feet Retired	Percentage of Total	No. of Feet in Service	Percentage of Total	Year of First Installation	Average Age, <i>yr.</i>
3	Cast-iron unlined	212,030	1.6	197,725	16.6	14,305	0.1	1822	79.8
4		637,022	4.8	491,147	41.1	145,875	1.2	1823	50.4
4½		430	0.0	430	0.0	0	0	1817	—
6		7,242,534	54.2	312,352	26.1	6,930,182	57.0	1821	47.9
8		1,931,677	14.5	13,047	1.1	1,918,630	15.8	1822	23.0
10		643,038	4.8	16,268	1.4	626,770	5.2	1821	54.4
12		1,156,658	8.7	46,306	3.9	1,110,352	9.1	1825	32.9
16		290,803	2.2	4,076	0.3	286,727	2.4	1829	42.0
18		2,031	0.0	0	0	2,031	0.0	1890	50.5
20		326,411	2.4	43,858	3.7	282,553	2.3	1819	49.9
22		2,660	0.0	2,660	0.2	0	0	1819	—
24		119,523	0.9	73	0.0	119,450	1.0	1871	17.1
30		309,830	2.3	42,889	3.6	266,941	2.2	1819	51.3
36		114,653	0.9	4,693	0.4	109,960	0.9	1830	45.4
48		291,740	2.2	19,074	1.6	272,666	2.2	1861	39.3
60		4,830	0.0	0	0	4,830	0.0	1921	18.4
72		13,514	0.1	0	0	13,514	0.1	1930	10.5
93		13,150	0.1	0	0	13,150	0.1	1930	10.5
12	Steel	2,801	0.0	0	0	2,801	0.0	1930	9.8
16		120	0.0	0	0	120	0.0	1935	5.5
20		151	0.0	0	0	151	0.0	1908	32.5
30		1,590	0.0	0	0	1,590	0.0	1930	10.0
36		1,014	0.0	0	0	1,014	0.0	1921	18.5
48		31,819	0.3	0	0	31,819	0.3	1901	23.4
60		2,739	0.0	0	0	2,739	0.0	1921	19.5
93		5,651	0.0	0	0	5,651	0.1	1930	10.5
TOTAL		13,358,419	100.0	1,194,598	100.0	12,163,821	100.0		42.3
Percentage of Total		100.00		8.94		91.06			
Average Size, <i>in.</i>		9.64		7.22		9.90			

Mortality Survival Ratios

Size, in.	Kind	No. of Feet	Period Covered, yr	Percentage
3	Cast-iron unlined	212,030	118.5	4.697
4 and 4½		637,452	117.5	11.896
6		7,242,534	119.5	84.290
8		1,931,677	118.5	94.309
10 and 12		1,799,696	117.5	89.657
20		326,411	121.5	33.895
Over 12 (Excl. 20)		1,162,734	111.5	71.518
12-93	Steel	45,885	39.5	100.000
TOTAL		13,358,419		

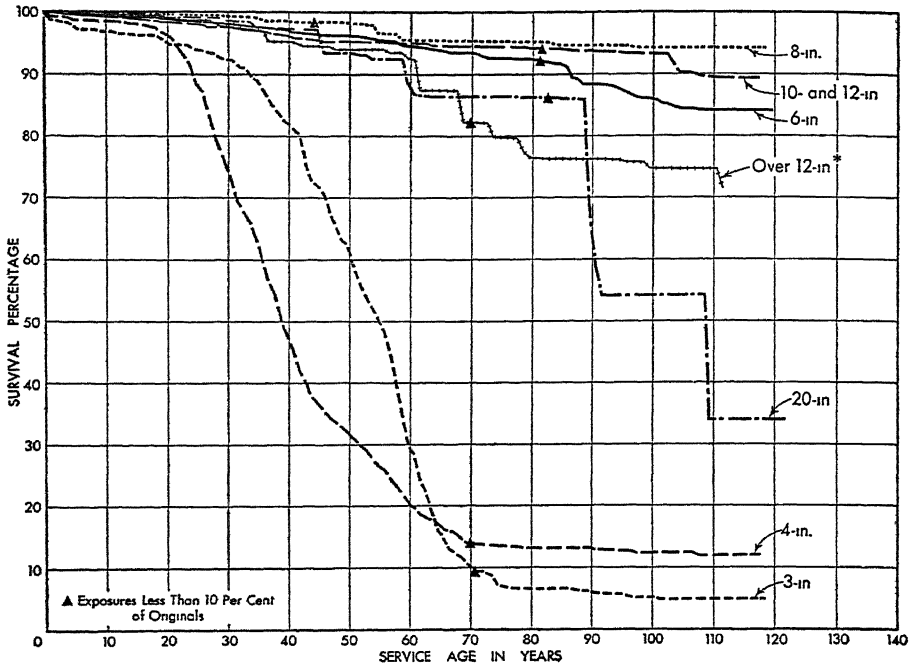


FIG. 1. Mortality Survival Curve—3-93-in. Cast-Iron Unlined Mains—
Philadelphia, Pennsylvania

BASE: Feet	SURVIVAL 1819-1940	
SIZE	EXPOSURES	RETIREMENTS
in.	ft.	ft
3	212,030	197,725
4	637,022	491,147
6	7,242,534	312,352
8	1,931,677	13,047
10 and 12	1,799,696	62,574
Over 12*	1,164,379	72,758
20	326,411	43,858

* Excluding 20-in.

The record of pipe installations and retirements in Philadelphia represents probably the best and certainly the longest of any similar record pertaining to an American city of like size.

Acknowledgments

The collection and compilation of the data in Philadelphia were done by per-

sonnel under the direction of E. H. Aldrich, Supervising Co-ordinator of the Committee on Survival and Retirement Experience With Water Works Facilities, with the co-operation of the Philadelphia Bureau of Water, of which the late Seth M. Van Loan was Chief, and George S. Levering, head of the distribution subdivision.

TABLE 2
CAUSES OF RETIREMENTS OF CAST-IRON UNLINED MAINS
PHILADELPHIA, PENNSYLVANIA

Size, in.	No. of Feet Retired	No of Feet Abandoned	Percentage of Total	No. of Feet Taken Up	Percentage of Total	Cause of Retirement
3	71,248	29,005	40.7	42,243	59.3	Not given Replaced
	125,008	18,507	14.8	106,501	85.2	
	196,256	47,512	24.2	148,744	75.8	
4	158,418	54,020	34.1	104,398	65.9	Not given Replaced Grade crossing Park construction Sewer construction
	331,068	36,497	11.0	294,571	89.0	
	631	538	85.3	93	14.7	
	887	887	100.0	0	0.0	
	143	0	0.0	143	100.0	
	491,147	91,942	18.7	399,205	81.3	
6	103,922	58,508	56.3	46,414	43.7	Not given Replaced Subway construction Street abandoned Street changes Railroad improvements Grade crossing Sewer construction Bridge construction Park construction Miscellaneous
	162,235	41,955	25.9	120,280	74.1	
	32,221	653	2.0	31,568	98.0	
	1,924	1,886	98.0	38	2.0	
	1,787	582	32.6	1,205	67.4	
	392	367	93.6	25	6.4	
	1,146	167	14.6	979	85.4	
	379	234	61.7	145	38.3	
	1,382	1,157	83.7	225	16.3	
	2,249	2,249	100.0	0	0.0	
	4,715	2,878	61.0	1,837	39.0	
	312,352	109,636	34.5	202,716	65.5	
8	5,444	3,571	65.6	1,873	34.4	Not given Replaced Subway construction Street changes Railroad improvements Grade crossing
	5,549	1,575	28.4	3,974	71.6	
	1,464	90	6.1	1,374	93.9	
	308	300	97.4	8	2.6	
	226	226	100.0	0	0.0	
	56	0	0.0	56	100.0	
	13,047	5,762	44.2	7,285	55.8	
10	7,761	4,278	55.1	3,483	44.9	Not given Replaced Subway construction Sewer construction Street change Railroad improvements Miscellaneous
	5,521	1,525	27.6	3,996	72.4	
	2,639	0	0.0	2,639	100.0	
	18	18	100.0	0	0.0	
	26	0	0.0	26	100.0	
	277	277	100.0	0	0.0	
	6	0	0.0	6	100.0	
	16,248	6,098	37.5	10,150	62.5	

TABLE 2 (contd.)

Size, in.	No. of Feet Retired	No. of Feet Abandoned	Percentage of Total	No. of Feet Taken Up	Percentage of Total	Cause of Retirement
12	13,796	5,808	42.1	7,988	57.9	Not given
	21,871	4,942	22.6	16,929	77.4	Replaced
	8,512	0	0.0	8,512	100.0	Subway construction
	1,034	0	0.0	1,034	100.0	Bridge construction
	473	373	78.9	100	21.1	Street changes
	588	588	100.0	0	0.0	Grade crossing
	32	0	0.0	32	100.0	Railroad improvements
	46,306	11,711	25.0	34,595	75.0	
16	699	31	4.4	668	95.6	Not given
	3,359	1,626	48.4	1,733	51.6	Replaced
	18	0	0.0	18	100.0	Subway construction
	4,076	1,657	40.7	2,419	59.3	
20	24,468	3,450	14.1	21,018	85.9	Not given
	6,012	566	9.4	5,446	90.6	Replaced
	6,512	0	0.0	6,512	100.0	Subway construction
	6,866	6,866	100.0	0	0.0	Park construction
	43,858	10,882	24.8	32,976	75.2	
22	1,050	1,050	100.0	0	0.0	Not given
	1,610	0	0.0	1,610	100.0	Replaced
	2,660	1,050	39.5	1,610	60.5	
24	73	0	0	73	100.0	Not given
	73	0	0	73	100.0	
30	38,625	17,985	46.6	20,640	53.4	Not given
	3,394	1,457	42.9	1,937	57.1	Replaced
	71	0	0.0	71	100.0	Subway construction
	799	799	100.0	0	0.0	Park construction
	42,889	20,241	47.2	22,648	52.8	
36	4,464	3,618	81.0	846	19.0	Not given
	229	0	0.0	229	100.0	Replaced
	4,693	3,618	77.1	1,075	22.9	
48	16,312	9,199	56.4	7,113	43.6	Not given
	2,702	1,442	53.4	1,260	46.6	Replaced
	19,014	10,641	56.0	8,373	44.0	
TOTAL	1,192,619	320,750	26.9	871,869	73.1	

TABLE 2 (contd.)

Summary

Size, in.	No of Feet Retired	No. of Feet Abandoned	Percentage of Total	No. of Feet Taken Up	Percentage of Total	Cause of Retirement
All	446,280	189,523	42.5	256,757	57.5	Not given
	668,558	110,092	16.5	558,466	83.5	Replaced
	2,421	1,293	53.4	1,128	46.6	Grade crossing
	10,801	10,801	100.0	0	0	Park construction
	540	252	46.7	288	53.3	Sewer construction
	51,437	743	1.4	50,694	98.6	Subway construction
	1,924	1,886	98.0	38	2.0	Street abandoned
	2,594	1,255	48.3	1,339	51.7	Street change
	927	870	93.9	57	6.1	Railroad improvements
	2,416	1,157	47.9	1,259	52.1	Bridge construction
	4,721	2,878	61.0	1,843	39.0	Miscellaneous
TOTAL	1,192,619	320,750	26.9	871,869	73.1	

PIPE ABANDONED OR TAKEN UP—SHOWING CAUSES OF RETIREMENT

3-IN. CAST-IRON UNLINED MAINS

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.	Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—NOT GIVEN				CAUSE OF RETIREMENT—NOT GIVEN (contd.)			
663	0.5	192	471	6,873	42.5	6,125	748
185	2.5		185	2,892	43.5	345	2,547
180	5.5		180	482	44.5	53	429
68	8.5	68		120	45.5		120
721	18.5	721		4,813	46.5	1,317	3,496
449	19.5	424	25	1,122	47.5	315	807
717	20.5	657	60	2,337	48.5	28	2,309
35	21.5	35		266	49.5		266
363	23.5	363		1,632	50.5	1,587	45
233	24.5	233		2,466	51.5	271	2,195
32	25.5		32	1,267	52.5	1,033	234
753	26.5	737	16	1,405	53.5	233	1,172
27	27.5		27	490	54.5		490
1,728	28.5		1,728	1,768	55.5	1,076	692
27	29.5		27	3,931	56.5	795	3,136
2,092	31.5	55	2,037	2,595	57.5	1,332	1,263
3,165	33.5		3,165	1,292	58.5	156	1,136
70	34.5	50	20	1,119	59.5	326	793
1,152	35.5		1,152	2,442	60.5	500	1,942
2,862	36.5	958	1,904	3,082	61.5	1,487	1,595
478	37.5	28	450	1,042	62.5	900	142
749	38.5	722	27	2,889	63.5	935	1,954
344	39.5	12	332	670	64.5		670
590	40.5	590		337	65.5	27	310
368	41.5		368	253	66.5		253

TABLE 2 (contd.)

3-IN. CAST-IRON UNLINED MAINS (contd.)

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.	Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—NOT GIVEN (contd.)				CAUSE OF RETIREMENT—REPLACED (contd.)			
421	67.5	149	272	2,297	43.5	626	1,671
27	68.5		27	1,313	44.5	27	1,286
378	69.5		378	2,449	45.5	463	1,986
3,517	74.5	3,055	462	1,605	46.5	524	1,081
154	76.5		154	3,646	47.5	458	3,188
38	88.5	38		1,869	48.5	306	1,563
510	90.5	510		1,850	49.5		1,850
300	96.5	300		5,731	50.5	2,025	3,706
247	101.5	247		2,900	51.5	596	2,304
20	103.5	20		3,900	52.5		3,900
				2,068	53.5	28	2,040
71,248		29,005	42,243	3,072	54.5		3,072
CAUSE OF RETIREMENT—REPLACED				2,488	55.5		2,488
2,165	0.5	839	1,326	3,183	56.5	446	2,737
266	2.5	240	26	6,759	57.5	1,614	5,145
1,360	4.5	1,360		10,142	58.5	432	9,710
1,300	5.5		1,300	8,084	59.5	76	8,008
128	9.5		128	1,303	60.5		1,303
716	11.5	716		5,276	61.5	483	4,793
567	14.5		567	3,909	62.5	730	3,179
31	17.5		31	3,931	63.5	27	3,904
1,419	19.5		1,419	4,845	64.5	1,036	3,809
23	21.5	23		3,335	65.5	461	2,874
261	23.5		261	3,062	66.5	1,331	1,731
914	24.5	4	910	1,081	67.5	175	906
22	25.5		22	1,660	68.5		1,660
306	28.5		306	2,295	69.5	52	2,243
112	29.5		112	1,704	70.5	788	916
469	30.5		469	142	71.5		142
523	31.5		523	646	73.5	311	335
27	32.5		27	710	75.5	512	198
62	33.5		62	28	76.5		28
1,022	34.5	349	673	219	79.5	219	
1,550	35.5		1,550	43	87.5		43
1,363	36.5	8	1,355	222	88.5		222
1,657	37.5	149	1,508	102	90.5	102	
2,529	38.5	27	2,502	175	92.5	175	
1,859	39.5	27	1,832	587	95.5		587
933	40.5	296	637				
1,926	41.5	396	1,530	125,008		18,507	106,501
2,867	42.5	50	2,817	196,256		47,512	148,744

TABLE 2 (contd.)

4-IN. CAST-IRON UNLINED MAINS

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.	Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—NOT GIVEN				CAUSE OF RETIREMENT—NOT GIVEN (contd.)			
20	0.5	20		3,467	58.5	1,814	1,653
558	1.5	395	163	4,372	59.5	2,918	1,454
100	2.5		100	1,089	60.5	792	297
689	4.5	473	216	4,033	61.5	1,000	3,033
82	11.5	82		977	62.5		977
767	12.5	767		1,194	63.5	857	337
13	13.5	13		1,857	64.5	90	1,767
51	14.5		51	412	66.5		412
632	15.5		632	659	67.5		659
245	16.5		245	751	68.5	117	634
591	17.5	493	98	2,322	69.5	140	2,182
1,691	18.5	1,691		421	70.5	58	363
1,200	19.5		1,200	563	71.5	347	216
795	20.5	454	341	80	72.5		80
6,313	21.5	2,515	3,798	850	78.5	850	
2,338	22.5	304	2,034	33	87.5		33
3,181	23.5	1,459	1,722	225	90.5	225	
3,332	24.5	797	2,535	392	93.5	392	
22	25.5		22	433	97.5	433	
3,102	26.5		3,102	430	98.5	430	
831	27.5		831	172	107.5		172
5,240	28.5	3,035	2,205				
427	29.5	21	406	158,418		54,020	104,398
3,232	30.5	1,554	1,678	CAUSE OF RETIREMENT—REPLACED			
10,086	31.5	1,356	8,730	1,327	0.5	300	1,027
3,133	32.5	21	3,112	195	1.5		195
2,260	33.5	127	2,133	617	2.5	376	241
2,704	34.5	286	2,418	2,081	4.5	1,905	176
6,356	35.5	3,436	2,920	1,676	5.5	487	1,189
5,744	36.5	2,198	3,546	166	6.5		166
1,473	37.5	137	1,336	959	8.5		959
9,119	38.5	76	9,043	54	11.5		54
2,983	39.5	1,442	1,541	1,217	12.5	1,217	
2,204	40.5		2,204	20	13.5		20
7,043	41.5	4,587	2,456	211	14.5	13	198
2,394	42.5	942	1,452	87	15.5		87
3,244	43.5	80	3,164	1,061	16.5		1,061
1,900	44.5	224	1,676	202	17.5		202
3,750	45.5	3,050	700	1,514	18.5		1,514
2,340	46.5	1,474	866	2,854	19.5	625	2,229
298	47.5		298	1,907	20.5	498	1,409
1,030	48.5	173	857	2,167	21.5	37	2,130
3,356	49.5		3,356	6,311	22.5	875	5,436
2,091	50.4	952	1,139	4,107	23.5	21	4,086
4,018	51.5	1,052	2,966	13,168	24.5	1,188	11,980
2,706	52.5	873	1,833	10,040	25.5	1,825	8,215
3,400	53.5	776	2,624	14,833	26.5	167	14,666
4,436	54.5	2,432	2,004	18,494	27.5	190	18,304
1,635	55.5	767	868	12,788	28.5	295	12,493
5,306	56.5	2,727	2,579				
3,225	57.5	296	2,929				

TABLE 2 (contd.)

4-IN. CAST-IRON UNLINED MAINS (cont'd)

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.	Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—REPLACED (contd.)				CAUSE OF RETIREMENT—NOT GIVEN (contd.)			
11,757	29.5	908	10,849	3,562	65.5	1,597	1,965
11,891	30.5	1,383	10,508	427	66.5		427
10,888	31.5	957	9,931	4,013	67.5	1,567	2,446
7,312	32.5	762	6,550	2,814	68.5	119	2,695
6,250	33.5	650	5,600	678	69.5		678
11,086	34.5	796	10,290	96	70.5		96
13,331	35.5	1,929	11,402	808	72.5	176	632
12,335	36.5	637	11,698	155	73.5		155
10,268	37.5	166	10,102	383	74.5	383	
15,208	38.5	1,653	13,555	10	76.5		10
12,034	39.5	589	11,445				
11,553	40.5	1,577	9,976	331,068		36,497	294,571
12,014	41.5	440	11,574				
7,971	42.5	879	7,092	CAUSE OF RETIREMENT—GRADE CROSSING CONSTR.			
9,667	43.5	434	9,233	402	51.5	402	
4,358	44.5	144	4,214	93	52.5		93
3,404	45.5		3,404	136	59.5	136	
3,890	46.5	355	3,535				
3,432	47.5	35	3,397	631		538	93
2,925	48.5		2,925				
2,037	49.5	320	1,717	CAUSE OF RETIREMENT—PARK, NOT USED			
3,624	50.5	1,210	2,414	418	60.5	418	
604	51.5	29	575	469	61.5	469	
1,066	52.5	404	662				
3,408	53.5	717	2,691	887		887	
3,144	54.5		3,144				
2,128	55.5	258	1,870	CAUSE OF RETIREMENT—SEWER CONSTR.			
1,942	56.5	324	1,618	143	73.5		143
3,205	57.5	1,151	2,054				
4,758	58.5	1,038	3,720	143			143
706	59.5	417	289				
2,133	60.5	833	1,300				
4,261	61.5	978	3,283				
2,715	62.5	563	2,152				
1,238	63.5		1,238				
1,523	64.5	100	1,423	491,147		91,942	399,205

6-IN. CAST-IRON UNLINED MAINS

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.	Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—NOT GIVEN				CAUSE OF RETIREMENT—NOT GIVEN (contd.)			
391	10.5		391	884	4.5	262	622
1,285	1.5	509	776	1,650	5.5	1,604	46
1,257	2.5	418	839	2,108	6.5	1,650	458
1,412	3.5	162	1,250	280	7.5	44	236

TABLE 2 (contd.)

6-IN. CAST-IRON UNLINED MAINS (contd.)

Length <i>ft.</i>	Life <i>yr.</i>	Abandoned <i>ft.</i>	Taken Up <i>ft.</i>	Length <i>ft.</i>	Life <i>yr.</i>	Abandoned <i>ft.</i>	Taken Up <i>ft.</i>
CAUSE OF RETIREMENT—NOT GIVEN (contd.)				CAUSE OF RETIREMENT—NOT GIVEN (contd.)			
316	8.5	158	158	576	56.5	576	
887	9.5	860	27	1,792	57.5	228	1,564
642	10.5	272	370	717	58.5	592	125
979	11.5	861	118	411	59.5	405	6
1,536	12.5	426	1,110	526	60.5		526
631	13.5	401	230	1,423	61.5	450	973
1,232	14.5	385	847	100	62.5	100	
514	15.5	416	98	913	63.5	523	390
1,620	16.5	1,607	13	740	64.5	730	10
902	17.5	900	2	1,306	65.5	484	822
1,979	18.5	1,291	688	1,443	66.5	1,280	163
2,678	19.5	935	1,743	836	67.5	91	745
2,188	20.5	807	1,381	274	68.5		274
1,724	21.5	1,366	358	204	69.5	125	79
2,836	22.5		2,836	25	70.5		25
1,794	23.5	1,556	238	862	71.5	403	459
1,693	24.5	580	1,113	492	72.5	450	42
615	25.5	106	509	29	73.5		29
938	26.5	700	238	200	74.5	200	
807	27.5	43	764	128	75.5		128
914	28.5	776	138	580	76.5	321	259
2,353	29.5	1,529	824	552	77.5	552	
2,549	30.5	2,412	137	100	78.5	100	
726	31.5	475	251	821	79.5	796	25
1,886	32.5	1,274	612	671	80.5	558	113
1,657	33.5	1,433	224	388	81.5	380	8
3,327	34.5	1,980	1,347	530	82.5	530	
1,673	35.5	1,546	127	323	83.5	323	
3,633	36.5	3,440	193	44	84.5	44	
1,978	37.5	1,773	205	19	85.5		19
481	38.5	193	288	36	86.5		36
1,057	39.5	1,048	9	966	88.5	167	799
2,474	40.5	1,720	754	524	90.5		524
1,363	41.5	940	423	583	91.5		583
1,595	42.5	887	708	546	92.5		546
681	43.5	469	212	468	93.5		468
1,000	44.5	270	730	154	94.5		154
376	45.5	313	63	2,425	95.5		2,425
401	46.5		401	973	96.5		973
1,916	47.5	396	1,520	1,391	97.5	1,162	229
1,398	48.5	744	654	676	99.5	657	19
103	49.5	21	82	164	100.5	20	144
1,740	50.5		1,740	96	102.5		96
1,308	51.5	1,308		852	103.5	397	455
901	52.5		901	294	104.5	294	
220	53.5	42	178	436	107.5	436	
575	54.5		575				
994	55.5	826	168				
				103,922		58,508	46,414

TABLE 2 (contd.)

6-IN. CAST-IRON UNLINED MAINS (contd.)

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.	Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—REPLACED				CAUSE OF RETIREMENT—REPLACED (contd.)			
1,417	0.5	400	1,017	954	50.5	221	733
2,361	1.5	704	1,657	1,468	51.5	77	1,391
4,031	2.5	325	3,706	1,075	52.5	72	1,003
1,588	3.5	375	1,213	4,749	53.5		4,749
1,855	4.5	373	1,482	2,310	54.5	728	1,582
1,069	5.5	209	860	600	55.5		600
1,807	6.5	18	1,789	150	56.5		150
974	7.5	230	744	2,025	57.5	711	1,314
1,214	8.5	249	965	5,430	58.5		5,430
3,115	9.5	2,300	815	1,415	59.5	196	1,219
5,476	10.5	2,852	2,624	940	60.5	4	936
1,231	11.5	107	1,124	646	61.5	303	343
4,069	12.5	1,987	2,082	5,206	62.5	4,277	929
364	13.5	31	333	847	63.5	8	839
781	14.5	36	745	505	64.5		505
856	15.5	324	532	1,951	65.5		1,951
1,168	16.5	10	1,158	1,288	66.5	183	1,105
2,322	17.5	1,088	1,234	30	67.5	12	18
2,399	18.5	871	1,528	182	68.5		182
999	19.5	443	556	1,019	69.5		1,019
810	20.5	290	520	1,980	70.5		1,980
1,110	21.5		1,110	2,279	71.5	49	2,230
6,031	22.5	2,312	3,719	610	72.5		610
342	23.5	296	46	467	73.5	467	
3,139	24.5	851	2,288	64	74.5	64	
1,656	25.5	169	1,487	36	75.5	36	
2,659	26.5	546	2,113	15	76.5		15
2,185	27.5	668	1,517	675	77.5	38	637
2,127	28.5	1,233	894	25	78.5		25
2,379	29.5	1,177	1,202	20	80.5		20
2,345	30.5	1,191	1,154	837	81.5		837
2,417	31.5	903	1,514	80	82.5		80
2,197	32.5	492	1,705	60	83.5		60
2,655	33.5	465	2,190	23	84.5		23
1,181	34.5	106	1,075	3,889	85.5	964	2,925
4,941	35.5	27	4,914	8,243	86.5	1,378	6,865
3,102	36.5	118	2,984	40	88.5		40
1,745	37.5		1,745	75	89.5		75
3,814	38.5	2,079	1,735	22	91.5		22
3,019	39.5	536	2,483	230	93.5	230	
3,919	40.5	2,759	1,160	305	94.5		305
1,866	41.5	121	1,745	25	96.5		25
2,337	42.5	431	1,906	808	97.5		808
2,189	43.5	517	1,672	1,679	101.5	446	1,233
4,083	44.5	818	3,265	59	102.5		59
634	45.5		634	396	104.5		396
40	46.5		40				
607	48.5	94	513				
1,878	49.5	360	1,518	162,235		41,955	120,280

TABLE 2 (contd.)

6-IN. CAST-IRON UNLINED MAINS (contd.)

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.	Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—SUBWAY CONSTR.				CAUSE OF RETIREMENT— SUBWAY CONSTR (contd.)			
62	0.5		62	717	76.5		717
71	1.5		71	119	84.5		119
22	4.5		22	50	85.5		50
60	5.5		60	1,362	87.5		1,362
147	10.5		147	1,258	88.5		1,258
65	11.5		65	30	93.5		30
1,205	13.5		1,205	650	96.5		650
445	15.5		445	12	98.5		12
26	18.5		26	25	100.5		25
27	19.5		27	59	101.5		59
119	20.5		119	185	102.5		185
65	21.5	65					
420	22.5	420					
28	24.5	28		32,221		653	31,568
1,986	27.5		1,986	CAUSE OF RETIREMENT— STREETS ABANDONED			
410	28.5		410	30	15	26	4
35	29.5		35	25	4.5	25	
688	30.5	8	680	34	11.5		34
1,062	31.5	132	930	25	17.5	25	
1,195	32.5		1,195	183	18.5	183	
6	33.5		6	212	28.5	212	
7	34.5		7	265	32.5	265	
75	35.5		75	531	35.5	531	
210	36.5		210	30	37.5	30	
915	37.5		915	142	40.5	142	
172	38.5		172	309	47.5	309	
671	39.5		671	138	52.5	138	
521	40.5		521				
17	41.5		17	1,924		1,886	38
252	42.5		252	CAUSE OF RETIREMENT—STREET CHANGES			
27	43.5		27	15	0.5		15
287	44.5		287	60	3.5		60
137	45.5		137	220	6.5		220
469	47.5		469	22	7.5	22	
1,138	49.5		1,138	46	9.5		46
551	50.5		551	17	14.5	17	
961	51.5		961	40	16.5	40	
767	52.5		767	78	21.5	78	
478	53.5		478	375	23.5		375
1,877	54.5		1,877	97	25.5		97
88	55.5		88	300	27.5		300
88	56.5		88	27	37.5	27	
863	57.5		863	271	45.5	271	
3,001	58.5		3,001	92	71.5		92
1,118	59.5		1,118	127	85.5	127	
6	60.5		6				
609	62.5		609	1,787		582	1,205
2,019	63.5		2,019				
231	66.5		231				
1,321	71.5		1,321				
734	72.5		734				

TABLE 2 (contd.)

6-IN. CAST-IRON UNLINED MAINS (contd.)

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.	Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—RAILROAD IMPROVEMENTS				CAUSE OF RETIREMENT—PARK OR PARKWAY CONSTR.			
6	5.5	6		1,006	19.5	1,006	
179	6.5	179		50	21.5	50	
182	50.5	182		26	23.5	26	
25	82.5		25	305	24.5	305	
				394	58.5	394	
				468	61.5	468	
392		367	25	2,249		2,249	
CAUSE OF RETIREMENT—GRADE CROSSING				CAUSE OF RETIREMENT—HOUSING PROJECT			
2	7.5		2	440	1.5	26	414
190	8.5		190	439	1.5		439
266	13.5		266	CAUSE OF RETIREMENT—FROZEN PIPE			
172	22.5		172	206	2.5		206
99	32.5		99	CAUSE OF RETIREMENT—RELAID			
250	39.5		250	177	3.5		177
117	55.5	117		CAUSE OF RETIREMENT—WRONG LOCATION			
50	69.5	50		30	4.5		30
1,146		167	979	CAUSE OF RETIREMENT—60-IN. MAIN CROSSING			
CAUSE OF RETIREMENT—SEWER CONSTR.				30	12.5		30
28	9.5		28	CAUSE OF RETIREMENT—BUILDING			
8	18.5	8		50	15.5		50
44	22.5		44	CAUSE OF RETIREMENT—TEMPORARY FIRE MAIN			
26	24.5		26	2,852	24.5	2,852	
25	36.5	25		CAUSE OF RETIREMENT—RETAINING WALL			
201	42.5	201		15	30.5		15
20	43.5		20	CAUSE OF RETIREMENT—48-IN. MAIN			
27	55.5		27	476	30.5		476
379		234	145	4,715		2,878	1,837
CAUSE OF RETIREMENT—BRIDGE CONSTR.				312,352		109,636	202,716
65	15.5		65				
110	23.5		110				
218	31.5	168	50				
989	39.5	989					
1,382		1,157	225				

TABLE 2 (contd.)

8-IN. CAST-IRON UNLINED MAINS

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.	Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—NOT GIVEN				CAUSE OF RETIREMENT—REPLACED (contd.)			
7	0.5		7	47	15.5		47
50	1.5	50		28	17.5		28
31	2.5	5	26	4	19.5		4
59	3.5		59	513	21.5	513	
774	4.5	10	764	630	35.5	466	164
253	5.5		253	219	36.5		219
40	6.5		40	56	40.5		56
89	7.5	79	10	11	49.5		11
359	8.5	342	17	1,280	54.5		1,280
62	9.5	62		12	60.5		12
156	11.5		156				
349	14.5	349		5,549		1,575	3,974
10	15.5		10				
25	18.5		25	CAUSE OF RETIREMENT—SUBWAY CONSTR.			
21	19.5		21	13	5.5		13
49	20.5		49	286	12.5		286
5	21.5	5		97	14.5		97
77	22.5		77	751	32.5		751
850	24.5	850		146	34.5		146
28	27.5	28		64	83.5	64	
238	33.5	238		26	84.5	26	
22	35.5	22		81	96.5		81
129	39.5	129		1,464		90	1,374
521	43.5	521					
839	48.5	839		CAUSE OF RETIREMENT—STREET CHANGES			
60	49.5		60	300	2.5	300	
210	52.5		210	8	5.5		8
42	65.5	42		308		300	8
34	66.5		34				
55	74.5		55	CAUSE OF RETIREMENT—RAILROAD IMPROVEMENTS			
5,444		3,571	1,873	226	5.5	226	
CAUSE OF RETIREMENT—REPLACED				226		226	
34	0.5	34		CAUSE OF RETIREMENT—GRADE CROSSING			
112	1.5	50	62	56	13.5		56
93	2.5		93	56			56
41	3.5	41		13,047		5,762	7,285
203	5.5	12	191				
236	6.5	164	72				
190	7.5	60	130				
38	8.5	38					
875	9.5		875				
523	11.5		523				
28	13.5	28					
376	14.5	169	207				

TABLE 2 (contd.)

10-IN. CAST-IRON UNLINED MAINS

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.	Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—NOT GIVEN				CAUSE OF RETIREMENT—REPLACED (contd.)			
28	0.5	28		58	46.5		58
108	1.5	108		103	49.5	103	
434	3.5	434		45	54.5	45	
51	5.5		51	37	60.5	37	
15	8.5	15		36	71.5		36
48	10.5		48	10	77.5	10	
562	11.5		562	390	79.5		390
50	12.5	50		19	83.5		19
8	14.5		8	50	84.5		50
229	15.5	229		45	85.5	45	
39	17.5	39		175	94.5	175	
13	19.5		13	630	104.5		630
17	21.5		17	83	107.5		83
256	23.5	256					
4	24.5		4	5,521		1,525	3,996
215	25.5	215		CAUSE OF RETIREMENT—SUBWAY CONSTR.			
700	26.5	700		690	3.5		690
102	35.5		102	7	18.5		7
459	36.5	278	181	297	28.5		297
246	37.5		246	34	41.5		34
20	39.5	20		124	48.5		124
94	40.5	94		32	72.5		32
25	43.5	25		167	90.5		167
84	44.5	84		108	98.5		108
18	58.5	18		50	99.5		50
55	62.5	55		51	103.5		51
1,419	63.5	1,419		813	104.5		813
30	71.5	30		49	105.5		49
42	78.5		42	70	107.5		70
181	85.5	181		85	108.5		85
97	100.5		97	62	110.5		62
58	101.5		58				
2,054	103.5		2,054	2,639		0	2,639
7,761		4,278	3,483	CAUSE OF RETIREMENT—SEWER CONSTR.			
CAUSE OF RETIREMENT—REPLACED				18	1.5	18	
186	5.5		186	CAUSE OF RETIREMENT—NEW CONSTR.			
702	8.5		702	6	7.5	6	
829	10.5	777	52	CAUSE OF RETIREMENT—STREET CHANGES			
64	11.5		64	26	13.5		26
25	12.5		25	CAUSE OF RETIREMENT—RAILROAD IMPROVEMENTS			
20	16.5		20	277	55.5	277	
570	20.5		570	16,248		6,098	10,150
33	22.5		33				
23	24.5		23				
284	28.5	284					
1,013	29.5	10	1,003				
42	34.5		42				
39	35.5	39					
10	38.5		10				

TABLE 2 (contd.)
 12-IN. CAST-IRON UNLINED MAINS

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.	Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—NOT GIVEN				CAUSE OF RETIREMENT—REPLACED (contd.)			
617	0.5		617	235	16.5	235	
30	1.5		30	1,391	17.5	1,391	
158	2.5		158	537	18.5	537	
199	3.5	182	17	32	20.5		32
104	5.5		104	217	21.5	217	
80	6.5		80	534	23.5		534
36	8.5	36		628	25.5	118	510
16	9.5	16		2,158	26.5	7	2,151
75	10.5	52	23	293	30.5		293
896	12.5	872	24	219	31.5		219
127	13.5		127	48	32.5		48
54	14.5	54		284	33.5		284
793	15.5		793	56	34.5		56
1,084	16.5	12	1,072	120	38.5	120	
1,869	17.5	1,600	269	3,674	40.5		3,674
297	18.5		297	1,926	44.5		1,926
485	19.5		485	39	69.5		39
383	23.5	383					
2,618	25.5		2,618	21,871		4,942	16,929
28	28.5	28					
1,747	30.5	1,747		CAUSE OF RETIREMENT—SUBWAY CONSTR.			
860	31.5		860	86	6.5		86
48	32.5		48	60	7.5		60
66	35.5		66	922	12.5		922
263	38.5	175	88	72	28.5		72
421	39.5	421		13	29.5		13
14	40.5		14	1,060	32.5		1,060
196	41.5		196	586	34.5		586
49	80.5	49		540	35.5		540
181	81.5	181		3,443	36.5		3,443
13,796		5,808	7,988	577	37.5		577
CAUSE OF RETIREMENT—REPLACED				896	43.5		896
70	1.5	70		86	46.5		86
327	2.5		327	33	87.5		33
988	3.5		988	16	97.5		16
1,207	5.5	270	937	17	100.5		17
907	6.5	871	36	105	106.5		105
48	7.5		48	8,512		0	8,512
175	8.5	175		CAUSE OF RETIREMENT—BRIDGE CONSTR.			
231	9.5		231	107	4.5		107
739	10.5	270	469	860	5.5		860
1,957	11.5	75	1,882	67	6.5		67
1,389	12.5		1,389	1,034		0	1,034
312	13.5	312					
539	14.5		539				
591	15.5	274	317				

TABLE 2 (contd.)

12-IN. CAST-IRON UNLINED MAINS (contd.)

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—STREET CHANGES			
4	37.5	4	
459	43.5	369	90
10	44.5		10
473		373	100

CAUSE OF RETIREMENT—GRADE CROSSING

588	61.5	588	
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CAUSE OF RETIREMENT—
RAILROAD IMPROVEMENT

32	77.5		32
46,306		11,711	34,595

16-IN. CAST-IRON UNLINED MAINS

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—NOT GIVEN			
86	23.5	31	55
200	41.5		200
267	47.5		267
99	81.5		99
47	95.5		47
699		31	668

CAUSE OF RETIREMENT—REPLACED

5	0.5		5
15	3.5		15
404	4.5	404	
20	20.5		20
1,170	22.5		1,170
122	23.5		122
71	36.5		71
1,286	42.5	1,222	64
54	44.5		54
51	80.5		51
51	92.5		51
110	99.5		110
3,359		1,626	1,733

16-IN. CAST-IRON UNLINED MAINS (contd.)

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—SUBWAY CONSTR.			
18	39.5		18
4,076		1,657	2,419

20-IN. CAST-IRON UNLINED MAINS

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
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CAUSE OF RETIREMENT—NOT GIVEN

147	0.5	32	115
250	5.5		250
89	12.5		89
38	15.5		38
185	19.5	83	102
22	28.5		22
378	31.5	278	100
303	32.5	303	
1,683	33.5		1,683
700	34.5		700
194	36.5		194
296	39.5	67	229
50	41.5		50
35	42.5		35
2,687	45.5	2,687	
50	50.5		50
532	51.5		532
4,997	59.5		4,997
2,141	60.5		2,141
82	84.5		82
2,700	90.5		2,700
6,909	109.5		6,909
24,468		3,450	21,018

CAUSE OF RETIREMENT—REPLACED

33	1.5		33
828	19.5	226	602
205	23.5		205
200	26.5		200
1,170	29.5		1,170
170	39.5	170	
1,149	53.5		1,149
170	62.5	170	
16	73.5		16
78	77.5		78
27	89.5		27
1,966	91.5		1,966
6,012		566	5,446

TABLE 2 (contd.)

20-IN. CAST-IRON UNLINED MAINS (contd.)

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—SUBWAY CONSTR.			
504	24.5		504
5,000	45.5		5,000
37	59.5		37
687	90.5		687
284	109.5		284
6,512		0	6,512

CAUSE OF RETIREMENT—PARK CONSTR.

6,866	89.5	6,866	
43,858		10,882	32,976

22-IN. CAST-IRON UNLINED MAINS

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
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CAUSE OF RETIREMENT—NOT GIVEN

1,050	79.5	1,050	
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CAUSE OF RETIREMENT—REPLACED

1,578	78.5		1,578
32	79.5		32
1,610		1,050	1,610
2,660		1,050	1,610

24-IN. CAST-IRON UNLINED MAINS

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
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CAUSE OF RETIREMENT—NOT GIVEN

10	1.5		10
63	6.5		63
73			73
73		0	73

30-IN. CAST-IRON UNLINED MAINS

Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
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CAUSE OF RETIREMENT—NOT GIVEN

312		312	
93	0.5		93
159	13.5		159
144	14.5		144
361	20.5	20	341
22	22.5		22
66	25.5		66
697	26.5		697
60	32.5	60	
71	33.5		71
156	34.5		156
14,343	36.5	14,343	
103	44.5	103	
92	46.5		92
1,630	47.5	1,630	
91	48.5		91
10,128	61.5	1,473	8,655
7,700	68.5		7,700
2,220	73.5		2,220
133	77.5		133
44	111.5	44	
38,625		17,985	20,640

CAUSE OF RETIREMENT—REPLACED

145	2.5	20	125
959	18.5	959	
232	22.5	93	139
394	26.5		294
427	30.5		427
530	35.5		530
230	36.5		230
20	41.5		20
195	44.5	195	
72	68.5		72
190	69.5	190	
3,394		1,457	1,937

CAUSE OF RETIREMENT—SUBWAY CONSTR.

71	17.5		71
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TABLE 2 (contd.)

30-IN. CAST-IRON UNLINED MAINS (contd.)				48-IN. CAST-IRON UNLINED MAINS			
Length ft.	Life yr.	Abandoned ft.	Taken Up ft.	Length ft.	Life yr.	Abandoned ft.	Taken Up ft.
CAUSE OF RETIREMENT—PARKWAY CONSTR.				CAUSE OF RETIREMENT—NOT GIVEN			
799	68.5	799		395		395	
42,889		20,241	22,648	163	13.5		163
36-IN. CAST-IRON UNLINED MAINS				2,027	20.5	42	1,985
Length ft.	Life yr.	Abandoned ft.	Taken Up ft.	140	24.5		140
CAUSE OF RETIREMENT—NOT GIVEN				1,513	26.5		1,513
45	0.5		45	205	27.5	205	
24	3.5		24	5,075	28.5	4,884	191
58	7.5		58	2,583	31.5		2,583
206	14.5		206	132	40.5	132	
963	16.5	963		1,892	41.5	1,892	
470	20.5	18	452	538	44.5		538
61	25.5		61	1,104	56.5	1,104	
501	32.5	501		545	61.5	545	
2,136	59.5	2,136		16,312		9,199	7,113
4,464		3,618	846	CAUSE OF RETIREMENT—REPLACED			
CAUSE OF RETIREMENT—REPLACED				42	0.5		42
207	6.5		207	53	4.5		53
22	13.5		22	1,342	5.5	1,119	223
229		3,618	229	415	12.5	323	92
4,693		3,618	1,075	850	20.5		850
				2,702		1,442	1,260
				19,014		10,641	8,373

TABLE 3

INSTALLATION OF PIPE—DATED BY COMMITTEE
PHILADELPHIA, PENNSYLVANIA

Size, in.	No. of Feet Retired	Percentage of Total Retired	No. of Feet in Service	Percentage of Total in Service
3	54,253	27.4	166	1.2
4	102,010	17.3	10,686	7.3
6	17,483	5.6	161,589	2.3
8	91	0.7	6,257	0.3
10	513	3.2	41,017	6.5
12	215	0.5	7,414	0.7
TOTAL	174,565	16.2	227,129	2.1

SUMMARY OF INSTALLATIONS AND RETIREMENTS PHILADELPHIA, PENNSYLVANIA

MAINS

3-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1822	851	0	851	1856	3,881	0	3,881
1823	430	0	430	1857	2,421	97	2,324
1824	3,542	0	3,542	1858	1,548	0	1,548
1825	2,793	0	2,793	1859	692	241	45
1826	8,783	446	8,337	1860	2,495	278	2,217
1827	18,280	317	17,963	1861	2,739	274	2,465
1828	10,371	336	10,035	1862	658	322	336
1829	2,974	188	2,786	1863	894	774	120
1830	28,164	1,009	27,155	1865	875	0	875
1831	7,852	358	7,494	1866	992	780	212
1832	5,194	365	4,829	1868	1,927	527	1,400
1833	4,666	207	4,459	1869	1,359	135	1,224
1834	1,631	396	1,235	1870	487	0	487
1835	9,088	264	8,824	1871	167	167	0
1836	6,131	0	6,131	1873	591	0	591
1837	5,132	0	5,132	1874	1,481	0	1,481
1838	2,872	221	2,651	1876	59	0	59
1839	2,886	11	2,875	1881	68	0	68
1840	12,062	1,259	10,803	1883	18	0	18
1841	2,131	0	2,131	1886	450	450	0
1842	1,459	365	1,094	1889	264	0	264
1843	894	258	636	1892	446	0	446
1844	1,518	206	1,312	1893	1,410	50	1,360
1845	4,289	225	4,064	1894	316	50	266
1846	4,020	265	3,755	1895	50	50	0
1847	1,508	75	1,433	1900	78	78	0
1848	4,439	87	4,352	1920	491	491	0
1849	7,646	410	7,236	1925	469	469	0
1850	7,501	0	7,501	1932	908	908	0
1851	1,654	110	1,544	1936	363	363	0
1852	5,102	0	5,102	1940	0	0	0
1853	2,608	0	2,608				
1854	27	0	27	TOTAL	212,030	14,305	197,725
1855	4,935	423	4,512				

Retirements by Years

Year							Year						
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1822	401	1885	450	1887			1826	666	1876	896	1880	49	1884
1823	140	1885	290	1886				2,538	1885	566	1888	1,161	1889
1824	3,042	1885	108	1891	250	1893		25	1890	253	1892	419	1893
	142	1895						613	1894	155	1895	603	1896
1825	734	1877	44	1880	146	1885		382	1899	11	1900		
	76	1886	87	1892	39	1893	1827	192	1827	1,419	1846	658	1877
	664	1894	635	1895	170	1899		675	1879	654	1873	1,029	1884
	198	1900						6,596	1885	3,106	1886	644	1888

3-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year						Year					
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year
1827	350	1889	29	1890	807	1891	1840	1,300	1868	2,632	1873
	308	1892	151	1893	445	1894		182	1886	438	1888
	633	1896	247	1928	20	1930		1,587	1890	712	1892
1828	346	1880	2,384	1885	465	1886		54	1894	1,015	1896
	8	1887	333	1888	862	1889		290	1898	198	1899
	447	1891	836	1892	1,730	1893		102	1906	510	1930
	1,123	1894	15	1895	807	1896	1841	180	1846	184	1879
	170	1897	466	1898	43	1915		339	1886	768	1888
1829	418	1886	27	1892	515	1893		389	1896		
	796	1894	226	1896	264	1902	1842	456	1888	236	1891
	512	1904	28	1905				123	1893	39	1894
1830	1,225	1866	6,125	1872	2,869	1876		99	1900		
	225	1877	722	1879	183	1883	1843	25	1890	19	1892
	1,411	1885	3,212	1886	829	1887		50	1899		
	966	1888	182	1889	1,419	1890	1844	500	1886	56	1889
	964	1892	1,924	1893	621	1894		54	1894	243	1896
	382	1896	134	1898	790	1899	1845	270	1885	20	1886
	2,780	1904	154	1906	38	1918		227	1889	1,021	1891
1831	289	1879	190	1883	459	1885		30	1894	396	1896
	1,666	1886	17	1887	949	1888		156	1899		
	284	1891	592	1892	976	1893	1846	135	1881	455	1884
	350	1894	355	1895	152	1896		450	1888	29	1889
	437	1897	27	1898	153	1900		9	1891	483	1892
	222	1919	376	1926				28	1894	548	1896
1832	298	1879	162	1880	421	1883	1847	43	1892	443	1893
	26	1887	400	1889	23	1891		398	1898	396	1899
	20	1892	1,000	1893	458	1894	1848	450	1878	1,612	1886
	10	1895	534	1896	236	1897		210	1893	24	1894
	797	1898	175	1899	94	1900		19	1898	606	1899
	175	1924						292	1905		
1833	1,488	1885	458	1886	446	1889	1849	422	1849	306	1877
	223	1892	388	1893	33	1894		899	1886	394	1890
	179	1896	1,025	1897	219	1912		314	1892	363	1893
1834	269	1883	152	1886	451	1891		418	1895	422	1896
	283	1892	80	1893				396	1900	128	1902
1835	832	1885	2,575	1886	450	1888	1850	721	1868	1,424	1885
	31	1890	441	1891	528	1892		146	1891	21	1892
	651	1893	1,074	1894	507	1895		27	1894	286	1895
	1,519	1896	216	1897				546	1900		
1836	74	1886	28	1892	493	1893	1851	285	1886	12	1890
	1,566	1894	901	1895	396	1896		98	1894	308	1896
	90	1898	1,314	1899	797	1900	1852	399	1886	23	1888
	172	1902	300	1932				22	1890	51	1892
1837	939	1885	390	1886	16	1887		758	1894	556	1896
	28	1890	435	1891	261	1892		2,019	1899	247	1900
	804	1893	57	1894	870	1896	1853	447	1886	119	1888
	252	1897	869	1899	211	1932		508	1893	399	1894
1838	564	1892	165	1893	447	1894		522	1899	282	1900
	416	1895	469	1896	590	1899	1854	27	1893		
1839	34	1886	392	1889	448	1890	1855	1,565	1886	31	1889
	477	1892	489	1893	263	1894		27	1892	493	1893
	629	1896	143	1902				788	1896	584	1897
								396	1900		

3-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year				Year				Year				Year			
Installed	Feet	Year	Feet	Year	Feet	Year	Feet	Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1856	344	1856	261	1879	27	1888		1862	336	1886					
	419	1890	26	1891	868	1892		1863	120	1898					
	786	1893	158	1894	992	1899		1865	657	1885	23	1886	195	1899	
1857	371	1857	28	1886	28	1888		1866	185	1868	27	1895			
	28	1891	544	1892	242	1893		1868	1,300	1873	100	1877			
	205	1902	322	1919	556	1931		1869	424	1888	778	1893	22	1894	
1858	19	1888	54	1894	765	1895		1870	60	1890	35	1891	363	1893	
	154	1896	556	1897					29	1894					
1859	49	1894	24	1896	32	1898		1873	566	1873	25	1892			
	78	1902	267	1904				1874	462	1874	716	1885	303	1888	
1860	737	1886	84	1889	86	1893		1876	28	1885	31	1893			
	372	1899	494	1900	355	1904		1881	68	1889					
	89	1923						1883	18	1931					
1861	25	1861	32	1886	16	1887		1889	264	1903					
	27	1888	428	1889	1,022	1892		1892	446	1892					
	62	1894	20	1895	24	1898		1893	1,360	1897					
	200	1899	342	1900	267	1903		1894	266	1896					

4-IN. CAST-IRON UNLINED MAINS

Year				Year			
Feet				Feet			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1823	275	275	0	1853	15,852	2,488	13,364
1824	1,352	0	1,352	1854	5,014	371	4,643
1825	527	0	527	1855	9,437	752	8,685
1826	5,962	0	5,962	1856	19,226	1,214	18,012
1827	8,740	1,624	7,116	1857	21,041	0	21,041
1828	2,701	1,645	1,056	1858	25,335	2,184	23,151
1829	4,426	0	4,426	1859	25,238	4,176	21,062
1830	13,861	620	13,241	1860	32,602	4,676	27,926
1831	657	0	657	1861	14,091	1,823	12,268
1832	3,100	1,232	1,868	1862	8,245	1,387	6,858
1833	3,483	382	3,101	1863	14,732	6,316	8,416
1834	1,610	1,274	336	1864	11,222	0	11,222
1835	8,210	1,231	6,979	1865	11,556	246	11,310
1836	3,334	0	3,334	1866	9,729	1,022	8,707
1837	3,973	2,838	1,135	1867	12,034	1,796	10,238
1838	5,542	0	5,542	1868	12,483	1,548	10,935
1839	3,247	309	2,938	1869	15,265	1,049	14,216
1840	24,899	2,320	22,579	1870	31,992	2,754	29,238
1841	2,786	0	2,786	1871	26,376	3,974	22,402
1842	5,534	975	4,559	1872	29,544	3,332	26,212
1843	6,019	51	5,968	1873	28,464	4,859	23,605
1844	1,732	446	1,286	1874	3,610	1,461	2,149
1845	12,286	2,041	10,245	1875	1,127	290	837
1846	649	24	625	1876	1,782	748	1,034
1847	520	444	76	1878	5,595	626	4,969
1848	72	0	72	1880	1,730	918	812
1849	1,388	41	1,347	1881	233	233	0
1850	13,565	300	13,265	1882	13	0	13
1851	5,841	1,031	4,810	1883	56	56	0
1852	18,219	3,350	14,869	1885	286	0	286

SURVIVAL AND RETIREMENT

4-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1886	151	79	72	1919	23	23	0
1887	305	276	29	1921	1,229	1,229	0
1889	57	0	57	1922	389	389	0
1894	5,272	4,922	350	1924	975	975	0
1895	42	12	30	1926	315	315	0
1897	722	246	476	1927	9,640	9,245	395
1898	163	0	163	1928	30,834	30,834	0
1899	770	612	158	1929	14,164	14,164	0
1900	147	147	0	1930	1,204	1,204	0
1902	28	28	0	1932	4	4	0
1904	5,386	5,366	20	1933	4	4	0
1905	978	978	0	1934	31	31	0
1906	1,679	166	1,513	1935	20	20	0
1907	27	27	0	1936	220	220	0
1908	1,130	180	950	1940	377	377	0
1910	771	20	751				
1911	1,525	1,010	515	TOTAL	637,022	145,875	491,147
1917	20	20	0				

Retirements by Years

<i>Year</i>	<i>Installed Feet</i>		<i>Year</i>	<i>Feet</i>		<i>Year</i>	<i>Feet</i>		<i>Year</i>	<i>Feet</i>	
	<i>Installed</i>	<i>Feet</i>		<i>Year</i>	<i>Feet</i>		<i>Year</i>	<i>Feet</i>		<i>Year</i>	<i>Feet</i>
1824	475	1878	481	1885	396	1886	1835	1,058	1895	363	1896
1825	527	1892						817	1899	392	1928
1826	288	1877	50	1878	2,987	1885	1836	420	1891	1,561	1893
	672	1886	50	1888	168	1890	1837	45	1871	404	1889
	1,457	1891	290	1893				389	1900	144	1904
1827	343	1877	1,280	1885	417	1886	1838	35	1889	552	1892
	32	1889	25	1890	40	1891		415	1894	1,799	1899
	478	1892	400	1893	995	1894		1,440	1906		
	1,334	1895	446	1896	788	1899	1839	526	1889	250	1892
	155	1900	383	1901				415	1894	399	1895
1828	321	1885	146	1890	22	1892	1840	341	1860	7,865	1871
	16	1894	200	1897	96	1898		167	1889	912	1891
	40	1900	10	1904	33	1915		1,654	1893	1,792	1894
	172	1935						2,571	1896	322	1897
1829	300	1858	1,208	1887	308	1892		2,429	1899	346	1901
	100	1893	2,510	1894				444	1908	143	1913
1830	2,999	1875	920	1876	452	1886	1841	883	1885	41	1890
	10	1887	27	1888	776	1889		124	1896	256	1897
	588	1892	1,073	1893	1,962	1894		269	1900		
	574	1895	423	1896	497	1897	1842	45	1872	23	1891
	230	1898	1,878	1899	391	1900		1,152	1893	50	1894
	216	1901	225	1920				308	1897	798	1899
1831	43	1892	28	1893	50	1894	1843	30	1874	438	1888
	476	1900	60	1903				212	1894	1,286	1896
1832	376	1889	19	1891	62	1892		1,836	1899	381	1900
	1,236	1893	28	1894	147	1903		158	1902		
1833	1,416	1886	5	1888	306	1891	1844	910	1885	347	1893
	908	1892	33	1894	433	1930	1845	758	1871	532	1880
1834	20	1893	88	1894	228	1901		149	1888	469	1889
1835	200	1870	75	1875	516	1885		2,223	1893	1,050	1894
	35	1886	29	1889	500	1891		395	1897	1,920	1899
	933	1892	1,587	1893	77	1894	1846	396	1896	229	1900

4-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year Installed Feet Year Feet Year Feet Year							Year Installed Feet Year Feet Year Feet Year						
1847	34	1886	42	1896			1859	201	1889	100	1890	374	1891
1848	72	1886						712	1892	1,767	1893	2,028	1894
1849	33	1887	40	1890	1,097	1892		396	1895	413	1896	1,579	1897
	129	1896	48	1898				1,298	1898	5,980	1899	869	1900
1850	372	1880	254	1885	1,744	1886		810	1901	408	1902	1,694	1905
	59	1888	534	1889	630	1891		307	1909	30	1919		
	466	1892	835	1893	1,821	1894	1860	396	1860	410	1879	972	1886
	51	1895	1,315	1896	2,835	1899		12	1887	540	1888	85	1889
	586	1900	838	1901	925	1902		593	1890	466	1891	1,307	1892
1851	90	1881	362	1886	47	1887		2,127	1893	3,120	1894	1,205	1895
	2,300	1888	403	1889	1,068	1892		2,978	1896	1,394	1897	2,273	1898
	85	1894	455	1896				4,994	1899	1,275	1900	1,046	1901
1852	445	1881	32	1885	1,022	1886		485	1903	366	1904	389	1905
	261	1891	6,096	1893	977	1894		498	1908	320	1909	272	1913
	19	1895	972	1896	734	1897		203	1920	170	1928	30	1930
	1,070	1899	536	1900	34	1901	1861	61	1861	450	1886	25	1888
	848	1902	60	1904	353	1905		27	1889	424	1891	2,848	1892
	666	1908	266	1909	478	1914		1,547	1893	849	1894	558	1897
1853	170	1885	819	1888	99	1890		2,559	1899	500	1900	257	1902
	1,292	1891	16	1892	1,825	1893		105	1903	398	1904	16	1906
	637	1894	392	1895	3,624	1896		438	1907	383	1909	152	1911
	612	1898	793	1899	521	1900		343	1913	328	1916		
	66	1902	1,162	1903	105	1911	1862	31	1862	24	1888	46	1890
	1,231	1913						43	1891	327	1892	594	1893
1854	220	1885	40	1891	27	1892		426	1894	72	1895	1,203	1896
	180	1893	1,228	1894	845	1896		1,833	1897	504	1898	52	1901
	1,376	1897	440	1899	287	1902		709	1902	349	1906	374	1908
1855	52	1888	33	1890	515	1891		271	1926				
	360	1892	710	1893	651	1894	1863	185	1864	165	1865	1,511	1886
	541	1895	852	1896	317	1897		28	1889	50	1892	2,244	1893
	1,470	1898	1,398	1899	224	1900		292	1894	2,201	1897	352	1899
	186	1902	400	1904	323	1908		1,114	1900	274	1902		
	653	1909					1864	1,102	1864	83	1869	4	1887
1856	1,435	1886	1,391	1887	1,378	1888		47	1890	339	1892	1,134	1893
	471	1890	436	1891	936	1892		610	1894	1,146	1895	644	1896
	771	1893	7,744	1894	783	1895		813	1897	559	1899	1,438	1900
	920	1896	352	1898	557	1899		960	1901	603	1902	1,024	1903
	418	1901	420	1903				696	1910	20	1913		
1857	174	1859	37	1878	440	1880	1865	2,428	1886	89	1889	77	1890
	1,055	1885	1,298	1886	27	1888		524	1891	28	1892	2,299	1893
	55	1889	329	1891	5,480	1892		179	1894	76	1895	896	1896
	1,373	1893	1,544	1894	1,180	1895		910	1897	1,000	1899	910	1900
	2,782	1896	876	1897	632	1898		681	1901	288	1905	23	1906
	1,952	1899	839	1900	420	1904		902	1908				
	364	1908	184	1924			1866	27	1866	487	1871	66	1889
1858	27	1858	338	1886	869	1889		900	1890	83	1891	455	1892
	70	1890	30	1891	1,326	1892		1,890	1893	246	1894	45	1895
	3,447	1893	3,666	1894	396	1895		325	1896	1,076	1897	548	1898
	4,606	1896	992	1897	3,764	1899		820	1899	947	1900	291	1903
	1,380	1900	359	1901	38	1911		408	1917	93	1918		
	968	1918	518	1919	357	1921	1867	1,905	1871	988	1885	453	1887
1859	564	1867	174	1878	1,358	1886		456	1888	970	1890	250	1891

SURVIVAL AND RETIREMENT

4-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year						Year					
Installed	Feet	Year	Feet	Year	Feet	Installed	Feet	Year	Feet	Year	Feet
1867	1,721	1893	185	1894	814	1872	836	1908	1,073	1909	28
	719	1896	611	1897	43		885	1913	494	1925	464
	777	1908	346	1909		1873	4	1887	593	1890	1,185
1868	38	1868	1,137	1889	42		1,125	1892	230	1893	593
	875	1893	853	1894	1,302		635	1895	1,754	1896	3,676
	1,339	1897	1,748	1898	1,451		4,097	1898	2,122	1899	773
	802	1900	50	1909	1,298		1,502	1901	383	1902	607
1869	422	1869	395	1877	54		446	1904	471	1905	456
	30	1889	82	1890	514		717	1908	1,582	1909	400
	56	1892	2,179	1893	533		254	1930			
	1,500	1895	2,576	1896	1,437	1874	679	1893	25	1894	32
	1,047	1898	2,105	1899	393		35	1896	303	1900	230
	25	1901	425	1902	443		656	1909	189	1913	
1870	13	1884	545	1886	16	1875	112	1875	75	1891	650
	27	1888	949	1889	1,087	1876	176	1880	82	1887	350
	374	1891	462	1892	836		52	1893	27	1894	347
	1,657	1894	847	1895	4,953	1878	1,984	1890	25	1892	50
	3,805	1897	5,450	1898	2,777		395	1898	2,515	1899	
	2,387	1900	393	1901	750	1880	812	1902			
	300	1903	190	1905	349	1882	13	1895			
	312	1913	378	1915	381	1885	194	1899	92	1914	
1871	689	1875	54	1882	206	1886	72	1888			
	229	1887	27	1888	140	1887	29	1893			
	416	1891	104	1892	3,587	1889	57	1889			
	992	1894	3,665	1895	245	1894	35	1894	15	1896	85
	3,485	1898	3,221	1899	761		215	1931			
	100	1901	451	1902	359	1895	30	1912			
	26	1906	87	1907	791	1897	450	1897	26	1911	
	918	1909	12	1911	1,125	1898	163	1900			
	136	1930	576	1932		1899	79	1925	79	1926	
1872	233	1872	8	1887	28	1904	20	1915			
	555	1891	178	1892	722	1906	28	1908	137	1912	1,348
	2,074	1894	659	1895	3,434	1908	950	1924			
	1,752	1897	3,451	1898	4,158	1910	263	1912	488	1932	
	399	1900	1,511	1901	823	1911	10	1912	505	1926	
	50	1903	575	1904	1,822	1927	395	1928			

4½-IN. CAST-IRON UNLINED MAINS

Year				Retirements by Years		
Installed	Installed	In Service	Retired	Year	Feet	Year
1817	430	0	430	1817	430	1915
1940	0	0	0			
TOTAL	430	0	430			

6-IN. CAST-IRON UNLINED MAINS

Feet				Feet			
<i>Year</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Year</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1821	1,921	1,921	0	1876	98,286	93,568	4,718
1822	12,997	1,752	11,245	1877	70,343	69,118	1,225
1823	4,836	3,985	851	1878	43,730	41,956	1,774
1824	8,926	8,870	56	1879	19,460	18,207	1,253
1826	15,627	15,523	104	1880	23,441	21,678	1,763
1827	30,979	28,104	2,875	1881	28,418	26,700	1,718
1828	20,812	18,529	2,283	1882	32,274	27,644	4,630
1829	15,023	13,384	1,639	1883	42,464	41,889	575
1830	24,831	19,548	5,283	1884	49,364	45,254	4,110
1831	8,920	5,535	3,385	1885	122,331	116,502	5,829
1832	15,162	14,631	531	1886	119,141	113,168	5,973
1833	16,617	14,543	2,074	1887	77,535	73,444	4,091
1834	16,653	10,919	5,734	1888	121,759	118,421	3,338
1835	39,059	33,747	5,312	1889	124,452	119,277	5,175
1836	15,022	11,779	3,243	1890	147,507	143,978	3,529
1837	12,306	9,014	3,292	1891	170,840	167,155	3,685
1838	17,014	13,931	3,083	1892	153,360	148,394	4,966
1839	16,734	15,133	1,601	1893	208,046	199,696	8,350
1840	25,177	24,282	895	1894	200,516	192,510	8,006
1841	7,210	7,201	9	1895	174,930	171,659	3,271
1842	5,764	4,989	775	1896	159,492	152,681	6,811
1843	3,826	2,511	1,315	1897	153,452	151,741	1,711
1844	10,812	8,697	2,115	1898	146,869	143,294	3,575
1845	22,652	20,200	2,452	1899	147,909	143,402	4,507
1846	12,385	11,334	1,051	1900	104,083	100,864	3,219
1847	5,505	5,472	33	1901	95,862	94,072	1,790
1848	12,388	10,759	1,629	1902	94,258	90,228	4,030
1849	5,240	4,780	460	1903	61,822	61,195	627
1850	29,013	27,693	1,320	1904	63,936	63,372	564
1851	5,660	4,959	701	1905	122,732	120,293	2,439
1852	33,332	29,788	3,544	1906	121,860	121,131	729
1853	27,118	25,247	1,871	1907	113,072	111,727	1,345
1854	11,980	9,588	2,392	1908	115,271	113,706	1,565
1855	33,624	31,952	1,672	1909	109,001	107,236	1,765
1856	40,672	35,648	5,024	1910	101,288	99,922	1,366
1857	38,072	35,535	2,537	1911	74,090	73,124	966
1858	46,619	43,059	3,560	1912	57,664	57,043	621
1859	51,943	47,269	4,674	1913	43,198	43,198	0
1860	81,675	75,239	6,436	1914	56,031	55,686	345
1861	40,848	31,659	9,189	1915	65,851	64,933	918
1862	32,322	26,357	5,965	1916	42,896	42,864	32
1863	38,301	35,346	2,955	1917	43,744	43,679	65
1864	23,805	20,764	3,041	1918	25,303	24,398	905
1865	30,507	27,941	2,566	1919	38,433	35,180	3,253
1866	27,785	24,213	3,572	1920	25,180	25,160	20
1867	58,792	49,421	9,371	1921	31,822	31,455	367
1868	52,953	49,850	3,103	1922	70,730	70,730	0
1869	79,710	61,745	17,965	1923	72,173	72,105	68
1870	86,069	81,656	4,413	1924	96,756	96,681	75
1871	102,259	96,012	6,247	1925	150,701	150,481	220
1872	99,149	93,980	5,169	1926	141,621	141,591	30
1873	143,962	137,866	6,096	1927	124,615	124,103	512
1874	182,405	175,224	7,181	1928	130,539	129,716	823
1875	141,325	137,703	3,622	1929	99,370	97,781	1,589

6-IN. CAST-IRON UNLINED MAINS (contd.)

Year				Year			
Feet				Feet			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1930	49,720	49,710	10	1937	7,889	7,889	0
1931	42,195	42,195	0	1938	9,166	9,166	0
1932	5,802	5,802	0	1939	17,349	17,349	0
1933	5,276	5,276	0	1940	11,972	11,972	0
1934	5,057	5,057	0				
1935	4,529	4,529	0	TOTAL	7,242,534	6,930,182	312,352
1936	9,460	9,460	0				

Retirements by Years

Year						Year							
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1822	5	1877	452	1885	60	1905	1839	192	1902	357	1904	182	1907
	2,485	1907	8,243	1908				821	1918	49	1931		
1823	851	1908					1840	168	1891	89	1892	97	1893
1824	56	1908						495	1911	36	1926	10	1931
1826	36	1901	48	1908	20	1926	1841	9	1876				
1827	350	1846	17	1890	339	1893	1842	108	1872	276	1883	72	1891
	15	1912	40	1915	22	1918		319	1901				
	78	1924	657	1926	446	1928	1843	320	1859	20	1894	400	1899
	59	1929	852	1930				350	1907	225	1931		
1828	630	1879	520	1894	253	1896	1844	1,450	1891	526	1894	18	1911
	48	1919	396	1932	436	1935		121	1932				
1829	396	1896	24	1901	445	1910	1845	33	1866	123	1898	480	1902
	650	1925	124	1931				85	1903	752	1904	938	1911
1830	694	1859	390	1888	360	1896		41	1925				
	84	1899	32	1912	40	1915	1846	186	1899	27	1901	51	1908
	75	1919	2,425	1925	505	1926		450	1918	321	1922	16	1930
	67	1930	160	1931	157	1932	1847	33	1866				
	294	1934					1848	54	1908	82	1911	125	1917
1831	897	1885	28	1888	25	1894		452	1919	9	1925	555	1930
	678	1919	230	1924	330	1925		238	1931	114	1932		
	52	1931	1,145	1932			1849	72	1929	388	1930		
1832	54	1886	468	1925	9	1931	1850	663	1890	205	1893	82	1894
1833	100	1898	165	1899	43	1905		360	1898	10	1899		
	127	1918	505	1925	1,124	1930	1851	281	1911	28	1912	392	1932
	10	1932					1852	2,572	1890	526	1894	134	1897
1834	731	1899	966	1904	2,230	1905		217	1904	2	1913	58	1921
	608	1906	473	1911	525	1925		10	1925	25	1930		
	189	1931	12	1932			1853	740	1866	35	1889	520	1896
1835	453	1874	4	1887	226	1889		64	1927	54	1929	458	1930
	45	1890	353	1894	166	1895	1854	1,465	1890	184	1891	550	1895
	37	1902	872	1904	1,014	1905		40	1902	25	1904	128	1929
	19	1908	578	1915	524	1925	1855	230	1859	300	1866	20	1892
	58	1929	155	1931	808	1932		65	1893	117	1894	85	1898
1836	1,824	1886	22	1893	32	1894		554	1906	25	1925	56	1926
	100	1898	797	1901	246	1902		15	1931	205	1932		
	85	1919	60	1921	19	1929	1856	685	1858	173	1859	296	1866
	8	1932	50	1936				60	1875	498	1876	268	1885
1837	555	1891	562	1902	54	1904		5	1886	492	1901	1,506	1904
	767	1922	1,200	1925	154	1931		324	1906	717	1932		
1838	375	1859	80	1893	801	1895	1857	564	1875	136	1894	20	1905
	75	1904	132	1915	1,362	1925		918	1918	56	1922	21	1925
	11	1931	247	1932				467	1930	200	1931	155	1934

6-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year							Year						
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1858	250	1859	232	1863	218	1864	1870	550	1872	400	1873	765	1890
	193	1882	81	1886	753	1892		256	1891	379	1894	15	1899
	420	1893	14	1894	15	1898		19	1903	28	1906	46	1911
	392	1899	155	1902	228	1915		131	1912	226	1913	588	1914
	493	1921	91	1925	25	1930		500	1915	510	1930		
1859	219	1860	339	1861	400	1863	1871	446	1871	559	1877	1,987	1883
	1,216	1890	25	1891	17	1892		724	1893	24	1894	349	1904
	32	1893	37	1894	376	1898		80	1913	96	1915	84	1921
	1,177	1911	150	1915	394	1917		1,650	1925	248	1930		
	10	1924	253	1925	29	1931		454	1873	14	1885	235	1889
1860	425	1861	177	1863	34	1887	1872	1,061	1890	61	1891	22	1893
	41	1888	433	1889	433	1890		655	1899	548	1901	57	1904
	317	1892	120	1893	545	1894		552	1906	366	1913	400	1914
	34	1896	84	1898	855	1900		230	1916	17	1926	69	1927
	477	1902	59	1907	77	1911		313	1930	115	1932		
	45	1915	140	1918	12	1927	1873	180	1875	123	1876	108	1877
	50	1929	1,321	1931	657	1932		24	1885	97	1887	256	1888
	100	1938						2	1892	22	1899	31	1900
	386	1864	398	1869	294	1876		1,235	1903	355	1904	13	1907
	76	1877	1,172	1890	223	1891		48	1910	271	1918	48	1921
1861	144	1892	637	1893	32	1894	1874	599	1924	550	1925	16	1927
	20	1898	669	1899	1,134	1900		1,499	1930	114	1932	505	1937
	2,759	1901	198	1902	438	1904		48	1881	240	1883	164	1887
	384	1926	225	1928				277	1889	7	1890	714	1891
	453	1886	10	1888	1,460	1898		247	1892	56	1894	27	1896
1862	1,418	1899	521	1916	2,019	1925	1875	60	1900	768	1904	218	1905
	84	1931						14	1906	15	1907	466	1909
	400	1864	385	1877	567	1891		550	1918	110	1921	362	1925
137	1893	425	1899	384	1901	217		1926	147	1929	176	1930	
20	1921	609	1925	16	1926	1,556		1931	742	1932			
12	1930					641		1877	32	1885	105	1892	
270	1875	356	1876	2,312	1886	36		1894	221	1901	113	1903	
41	1893	25	1894	37	1902	463		1905	41	1909	382	1918	
867	1886	986	1890	47	1894	10		1921	114	1925	741	1926	
343	1899	271	1904	22	1925	706		1930	17	1932			
30	1928					52	1878	55	1884	494	1886		
1866	550	1867	291	1886	143	1890	1876	30	1889	36	1890	115	1900
	275	1891	236	1899	60	1904		735	1903	476	1906	522	1908
	443	1909	1,118	1925	390	1930		134	1917	53	1920	221	1921
	66	1932						192	1922	1,138	1925	28	1931
1867	1,549	1877	629	1893	465	1894	1877	88	1932	349	1939		
	13	1905	791	1909	5,918	1925		29	1893	323	1908	20	1920
	6	1926						646	1926	188	1929	19	1932
1868	658	1868	72	1882	16	1892	1878	11	1884	81	1887	10	1890
	12	1897	1,612	1900	76	1911		55	1899	109	1907	36	1912
	532	1930	104	1931	21	1935		245	1915	408	1926	424	1930
	58	1884	261	1893	127	1896		227	1932	168	1933		
1869	498	1902	3,549	1904	1,002	1905	1879	235	1892	35	1896	50	1903
	24	1906	242	1907	33	1908		274	1927	182	1929	477	1932
	149	1910	455	1912	719	1913	1880	19	1892	26	1904	392	1905
	15	1921	4,563	1922	45	1923		768	1906	5	1911	250	1919
	13	1924	1,589	1930	4,623	1931		92	1930	155	1931	56	1939

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1881	273	1883	300	1908	356	1910			1890	40	1925	218	1926	18	1930
	37	1913	752	1930						252	1932	21	1939		
1882	252	1886	72	1893	2,614	1904			1891	56	1891	20	1892	346	1894
	71	1908	70	1912	320	1915				220	1896	37	1900	51	1902
	236	1918	295	1931	451	1932				610	1903	64	1904	59	1906
	249	1939								13	1908	115	1909	150	1911
1883	12	1891	25	1894	43	1898				27	1913	50	1915	225	1918
	27	1901	242	1907	31	1926				21	1920	895	1926	9	1928
	3	1927	30	1929	42	1931				184	1930	463	1931	35	1932
	120	1932								35	1934				
1884	170	1884	1,912	1894	121	1895			1892	287	1892	85	1893	50	1895
	601	1902	103	1908	381	1911				202	1896	50	1897	55	1898
	203	1913	537	1916	17	1925				202	1900	84	1901	28	1902
	65	1933								350	1903	80	1904	125	1909
1885	45	1887	26	1892	20	1896				12	1911	69	1912	13	1913
	60	1902	136	1903	375	1908				172	1914	238	1915	962	1916
	252	1910	254	1911	147	1913				248	1918	25	1923	36	1924
	127	1915	989	1924	1,306	1925				710	1925	9	1927	170	1929
	146	1926	581	1929	209	1931				232	1930	60	1931	51	1932
	469	1932	4	1933	683	1939				309	1934	52	1939		
1886	34	1886	12	1888	45	1893			1893	157	1893	50	1894	50	1895
	146	1898	11	1905	371	1910				32	1897	36	1898	439	1899
	141	1914	355	1915	97	1916				20	1901	64	1902	24	1903
	299	1918	45	1919	1,407	1920				50	1908	287	1909	620	1910
	81	1921	86	1925	791	1927				74	1911	738	1912	404	1913
	895	1928	18	1929	399	1930				168	1915	240	1916	160	1918
	240	1931	309	1933	191	1934				269	1919	25	1920	447	1921
1887	8	1887	204	1894	76	1896				440	1923	1,134	1925	157	1926
	330	1897	282	1898	35	1902				269	1929	65	1930	99	1931
	28	1903	120	1905	32	1909				1,784	1932	13	1933	35	1935
	35	1914	1,020	1915	102	1921			1894	769	1894	60	1895	779	1896
	801	1924	10	1925	136	1927				425	1897	260	1898	457	1899
	52	1932	267	1934	553	1935				229	1900	110	1901	107	1903
1888	76	1890	175	1893	234	1896				229	1904	129	1905	24	1906
	10	1899	27	1901	33	1903				106	1907	205	1908	91	1909
	25	1905	31	1906	21	1907				40	1910	456	1911	88	1912
	300	1910	212	1916	53	1917				109	1913	523	1915	42	1916
	30	1919	29	1927	142	1928				26	1917	331	1918	44	1921
	7	1931	1,472	1932	30	1935				26	1923	893	1925	140	1926
	431	1939								14	1927	36	1929	100	1930
1889	15	1892	143	1894	8	1896				869	1931	157	1933	132	1935
	1,080	1898	633	1903	1,006	1908			1895	50	1896	62	1898	25	1899
	18	1909	28	1911	97	1914				219	1901	175	1903	30	1904
	700	1915	113	1923	42	1925				29	1907	60	1908	25	1910
	58	1926	50	1929	273	1930				80	1911	138	1912	475	1917
	450	1931	9	1932	452	1933				160	1918	377	1919	55	1920
1890	12	1891	262	1894	30	1900				36	1921	26	1924	20	1925
	240	1901	1,860	1902	82	1909				131	1926	96	1929	479	1930
	25	1910	38	1911	28	1914				167	1932	356	1935		
	250	1915	73	1918	80	1922			1896	84	1896	50	1898	84	1900

6-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year						Year					
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year
1896	85	1901	75	1902	268	1903	1903	78	1924	54	1931
	91	1904	75	1905	40	1906	1904	427	1904	86	1905
	12	1908	91	1909	201	1910		12	1915	9	1925
	132	1911	100	1912	28	1913	1905	392	1907	7	1908
	8	1914	47	1915	178	1916		732	1911	34	1913
	22	1917	150	1918	15	1920		921	1923	119	1925
	169	1921	31	1922	20	1925		31	1929		
	779	1926	265	1928	977	1929	1906	81	1908	56	1910
	425	1930	1,000	1931	785	1932		100	1926	425	1930
	401	1933	63	1935			1907	58	1908	12	1909
1897	50	1897	113	1898	50	1899		30	1911	78	1915
	100	1901	46	1906	26	1907		120	1921	44	1925
	25	1908	50	1915	50	1918		46	1930		
	450	1920	46	1925	124	1928	1908	120	1909	5	1910
	8	1929	83	1930	47	1931		168	1915	11	1916
	161	1932	282	1933				349	1929	203	1931
1898	118	1900	43	1901	23	1905	1909	15	1909	23	1911
	29	1906	27	1907	25	1909		337	1915	385	1925
	40	1910	149	1911	212	1913		17	1927	191	1931
	14	1915	35	1916	111	1918	1910	12	1911	12	1912
	5	1919	26	1920	1,986	1925		547	1926	247	1931
	621	1926	42	1928	5	1932		500	1934		
1899	25	1933	39	1940			1911	50	1915	22	1918
	85	1899	30	1901	32	1903		233	1926	17	1928
	55	1907	30	1908	80	1909	1912	12	1912	206	1914
	426	1910	266	1912	14	1913		14	1917	12	1930
	704	1915	111	1916	183	1917	1914	14	1915	206	1917
	481	1918	38	1919	20	1920	1915	19	1916	645	1921
	558	1922	38	1929	710	1930		98	1926	9	1935
	65	1931	6	1932	575	1935	1916	32	1916		
	180	1900	25	1901	25	1902	1917	65	1926		
	190	1904	520	1906	119	1908	1918	905	1919		
1900	27	1911	50	1915	131	1916	1919	20	1924	246	1926
	61	1917	128	1918	50	1920		76	1932	1,661	1938
	252	1923	78	1924	126	1929	1920	14	1930	6	1931
	972	1930	249	1931	36	1932	1921	40	1921	60	1926
	57	1901	361	1903	53	1905	1923	68	1924		
	30	1906	55	1907	219	1910	1924	15	1926	20	1927
	100	1911	438	1913	55	1914	1925	71	1926	10	1927
	8	1919	75	1924	100	1929		82	1930	32	1931
	239	1930					1926	18	1927	12	1929
	30	1903	50	1905	129	1908	1927	15	1927	395	1928
1902	50	1909	711	1912	62	1917	1928	54	1929	200	1930
	2,852	1926	11	1927	3	1931		22	1932		
	107	1932	25	1935			1929	38	1931	1,020	1934
	13	1904	130	1905	2	1906		14	1940		
1903	3	1909	44	1910	190	1911	1930	4	1933	6	1935
	69	1913	5	1918	39	1919					

SURVIVAL AND RETIREMENT

8-IN. CAST-IRON UNLINED MAINS

Year				Year			
Feet				Feet			
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1822	1,680	1,680	0	1898	19,694	19,546	148
1823	1,421	1,395	26	1899	16,695	16,579	116
1824	4,321	4,257	64	1900	6,585	6,585	0
1826	1,703	1,703	0	1901	3,726	3,705	21
1827	2,223	2,223	0	1902	3,620	3,270	350
1829	2,181	1,890	291	1903	45,719	45,462	257
1835	1,570	1,528	42	1904	4,048	4,039	9
1841	500	500	0	1905	12,637	12,637	0
1845	500	500	0	1906	13,917	13,773	144
1853	12	0	12	1907	7,145	6,632	513
1855	876	876	0	1908	15,671	15,608	63
1856	685	630	55	1909	9,631	9,556	75
1857	3,535	3,535	0	1910	20,206	20,206	0
1858	3,713	3,713	0	1911	47,844	47,785	59
1859	2,737	2,737	0	1912	34,351	34,250	101
1860	2,693	2,659	34	1913	39,943	39,869	74
1861	762	762	0	1914	69,281	69,274	7
1863	842	842	0	1915	90,054	89,229	825
1864	1,369	1,369	0	1916	60,180	60,093	87
1865	2,026	2,026	0	1917	50,874	49,525	1,349
1866	412	412	0	1918	21,178	21,167	11
1869	3,680	2,830	850	1919	18,717	18,717	0
1870	2,665	2,665	0	1920	28,820	28,820	0
1871	1,732	1,732	0	1921	35,706	35,554	152
1873	3,534	1,366	2,168	1922	75,515	74,445	1,070
1874	10,755	10,755	0	1923	68,812	68,756	56
1875	5,072	5,072	0	1924	77,897	77,857	40
1876	5,475	5,415	60	1925	187,655	187,451	204
1878	891	891	0	1926	137,047	136,668	379
1881	3,912	3,912	0	1927	123,021	123,021	0
1882	1,134	1,123	11	1928	81,375	81,345	30
1883	5,282	5,282	0	1929	66,327	66,322	5
1884	831	831	0	1930	76,598	76,592	6
1886	2,766	2,766	0	1931	49,469	49,469	0
1887	3,913	3,913	0	1932	15,071	15,071	0
1888	3,608	3,608	0	1933	2,909	2,909	0
1889	326	326	0	1934	7,595	7,595	0
1890	1,959	1,934	25	1935	6,348	6,348	0
1891	3,284	3,284	0	1936	10,363	10,363	0
1892	10,856	10,202	654	1937	12,956	12,956	0
1893	22,021	21,124	897	1938	16,208	16,208	0
1894	32,277	31,372	905	1939	27,263	27,263	0
1895	8,314	8,314	0	1940	14,688	14,688	0
1896	16,934	16,621	313				
1897	11,336	10,847	489	TOTAL	1,931,677	1,918,630	13,047

Retirements by Years

Year				Year			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1823	26	1907		1856	55	1930	
1824	64	1907		1860	34	1926	
1829	210	1881	81	1869	850	1893	
1835	42	1900		1873	49	1893	52
1853	12	1913			787	1931	1,280
							1927

8-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year				Year			
Installed	Feet	Year	Feet	Installed	Feet	Year	Feet
1876	60	1925		1909	75	1910	
1882	11	1931		1911	12	1916	47 1926
1890	25	1908		1912	97	1926	4 1931
1892	77	1901	56 1932	1913	34	1913	10 1920 30 1922
1893	751	1925	146 1927	1914	7	1914	
1894	93	1896	156 1905 376 1908	1915	130	1922	30 1923 379 1926
	28	1911	5 1915 28 1921		286	1927	
	219	1930		1916	10	1920	77 1938
1896	20	1897	164 1931 129 1935	1917	17	1925	798 1926 534 1931
1897	489	1932		1918	11	1920	
1898	26	1901	122 1931	1921	120	1926	32 1930
1899	116	1932		1922	817	1926	253 1927
1901	21	1920		1923	56	1930	
1902	350	1910		1924	40	1927	
1903	61	1904	19 1906 83 1910	1925	204	1931	
	84	1916	10 1918	1926	300	1928	79 1931
1904	9	1910		1928	15	1930	15 1931
1906	144	1917		1929	5	1931	
1907	513	1928		1930	6	1931	
1908	63	1914					

10-IN. CAST-IRON UNLINED MAINS

Year				Year			
Installed	Feet	In Service	Retired	Installed	Feet	In Service	Retired
1821	132	0	132	1859	2,516	2,413	103
1823	2,352	2,218	134	1860	5,238	5,238	0
1824	2,552	2,400	152	1861	142	142	0
1825	2,025	2,025	0	1862	890	890	0
1826	7,935	7,305	630	1863	1,838	1,838	0
1827	16,479	15,380	1,099	1864	840	840	0
1828	16,243	14,075	2,168	1865	1,182	748	434
1829	825	825	0	1866	3,274	1,992	1,282
1830	7,556	7,514	42	1867	1,164	1,164	0
1831	4,086	3,886	200	1868	7,987	6,568	1,419
1832	3,567	3,177	390	1870	2,494	2,494	0
1833	3,669	3,669	0	1871	84	84	0
1834	2,672	2,662	10	1872	10,315	10,315	0
1835	15,461	14,819	642	1874	6,720	6,100	620
1836	1,207	1,152	55	1875	21,086	20,561	525
1837	1,397	1,397	0	1876	6,136	6,136	0
1839	2,257	2,257	0	1877	3,519	3,411	108
1840	4,882	4,230	652	1878	1,188	1,064	124
1841	391	391	0	1879	4,575	4,149	426
1843	1,246	1,246	0	1880	1,760	1,760	0
1844	7,457	7,457	0	1881	1,029	1,029	0
1845	17,342	17,342	0	1882	4,491	4,491	0
1846	2,760	2,760	0	1883	10,829	10,771	58
1851	37	0	37	1884	346	323	23
1852	8,442	8,432	10	1885	2,303	1,741	562
1853	1,105	1,105	0	1886	11,531	11,486	45
1855	2,169	2,169	0	1887	1,369	1,369	0
1857	600	600	0	1888	1,780	1,780	0

SURVIVAL AND RETIREMENT

10-IN. CAST-IRON UNLINED MAINS (contd.)

Feet				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1889	822	822	0	1912	9,616	9,616	0
1890	3,442	3,403	39	1913	15,433	15,382	51
1891	3,530	3,496	34	1914	20,728	20,728	0
1892	9,843	9,843	0	1915	20,742	20,694	48
1893	6,377	6,093	284	1916	14,005	14,005	0
1894	11,459	11,357	102	1917	5,082	5,082	0
1895	5,450	5,450	0	1918	3,975	3,975	0
1896	19,864	19,775	89	1919	2,096	2,096	0
1897	6,931	6,608	323	1920	11,005	10,228	777
1898	12,609	12,567	42	1921	12,296	12,281	15
1899	13,023	13,023	0	1922	1,411	1,411	0
1900	34,085	33,038	1,047	1923	623	623	0
1901	10,468	10,373	95	1924	18	18	0
1902	5,841	5,841	0	1925	202	202	0
1903	19,179	19,129	50	1926	1,547	1,547	0
1904	18,530	18,389	141	1927	124	124	0
1905	16,444	16,424	20	1928	690	0	690
1906	19,614	19,597	17	1929	45	45	0
1907	8,093	8,093	0	1931	56	28	28
1908	17,926	17,919	7	1940	0	0	0
1909	13,874	13,829	45				
1910	6,542	6,313	229	TOTAL	643,038	626,770	16,268
1911	5,926	5,913	13				

Retirements by Years

Year				Year			
Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1821	70	1928	62	1931			
1823	49	1928	85	1931			
1824	19	1907	50	1908	83	1931	
1826	630	1930					
1827	84	1871	45	1881	30	1898	
	32	1899	108	1925	800	1931	
1828	50	1927	2,105	1931	13	1932	
1830	42	1908					
1831	45	1916	97	1931	58	1932	
1832	390	1911					
1834	10	1911					
1835	246	1872	18	1893	36	1906	
	167	1925	175	1929			
1836	55	1898					
1840	256	1863	215	1865	181	1925	
1851	37	1911					
1852	10	1890					
1859	103	1908					
1865	434	1868					
1866	642	1874	640	1895			
1868	1,419	1931					
1874	161	1903	459	1910			
1875	525	1895					
1877	108	1878					
1878	124	1926					
1879	149	1908	277	1934			
1883	58	1929					
1884	23	1908					

12-IN. CAST-IRON UNLINED MAINS

<i>Year</i> <i>Installed</i>	<i>Feet</i>			<i>Year</i> <i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1825	5,885	5,763	122	1894	35,293	34,148	1,145
1827	508	508	0	1895	20,130	16,607	3,523
1828	800	800	0	1896	36,149	35,833	316
1831	1,340	1,340	0	1897	18,767	18,549	218
1832	1,456	1,440	16	1898	25,457	24,450	1,007
1835	3,348	3,348	0	1899	34,566	34,183	383
1836	849	849	0	1900	18,877	15,295	3,582
1837	213	213	0	1901	17,978	17,893	85
1840	308	308	0	1902	3,105	2,971	134
1842	1,113	1,080	33	1903	10,300	10,160	140
1843	4,095	4,095	0	1904	13,761	13,761	0
1844	400	400	0	1905	9,173	7,290	1,883
1846	490	490	0	1906	12,217	10,183	2,034
1847	2,669	2,669	0	1907	11,703	9,304	2,399
1848	446	446	0	1908	11,534	11,000	534
1849	469	420	49	1909	5,627	5,539	88
1850	1,976	1,795	181	1910	13,832	13,747	85
1853	414	382	32	1911	16,616	15,648	968
1857	2,558	2,558	0	1912	28,537	28,470	67
1859	12,792	12,323	469	1913	11,925	11,810	115
1861	1,392	1,392	0	1914	26,445	26,356	89
1862	1,058	1,019	39	1915	21,408	20,486	922
1865	1,448	1,448	0	1916	10,528	10,528	0
1866	2,882	2,882	0	1917	12,464	12,464	0
1868	2,515	2,515	0	1918	4,578	4,578	0
1869	4,836	4,073	763	1919	9,214	9,214	0
1870	680	680	0	1920	3,824	3,764	60
1871	4,045	4,045	0	1921	20,399	20,319	80
1872	336	336	0	1922	36,190	35,901	289
1873	10,503	10,258	245	1923	15,058	15,058	0
1874	6,803	6,803	0	1924	54,641	54,537	104
1875	6,279	6,214	65	1925	80,325	80,313	12
1876	12,109	12,049	60	1926	81,307	80,711	596
1877	3,611	3,611	0	1927	18,683	18,683	0
1878	3,020	3,020	0	1928	13,137	13,137	0
1879	6,896	3,047	3,848	1929	30,368	30,368	0
1881	16,483	13,419	3,064	1930	31,102	31,102	0
1882	1,511	1,511	0	1931	22,588	22,588	0
1883	10,966	10,545	421	1932	6,544	6,544	0
1884	13,059	13,059	0	1934	1,053	1,053	0
1885	26,426	24,598	1,828	1935	13,761	13,761	0
1886	12,928	12,393	535	1936	191	191	0
1887	3,381	3,381	0	1937	6,717	6,717	0
1888	3,350	3,018	332	1938	11,994	11,994	0
1889	13,358	4,759	8,599	1939	5,303	5,303	0
1890	10,908	10,908	0	1940	1,591	1,591	0
1891	9,718	8,139	1,579				
1892	8,148	5,126	3,022				
1893	20,920	20,775	145				
				TOTAL	1,156,658	1,110,352	46,306

SURVIVAL AND RETIREMENT

12-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years

Year				Year				Year				Year			
Installed	Feet	Year	Feet	Year	Feet	Year	Year	Installed	Feet	Year	Feet	Year	Feet	Year	Year
1825	17	1925	105	1931				1895	16	1904	23	1905	537	1913	
1832	16	1929							217	1916	66	1930			
1842	33	1929						1896	158	1898	75	1907	54	1910	
1849	49	1929							29	1930					
1850	181	1931						1897	86	1903	42	1908	77	1914	
1853	32	1930							13	1926					
1859	459	1902	10	1903				1898	48	1905	72	1926	860	1929	
1862	39	1931							27	1932					
1869	175	1877	588	1930				1899	383	1922					
1873	245	1906						1900	17	1903	1,600	1917	1,965	1930	
1875	65	1877						1901	85	1926					
1876	12	1885	48	1908				1902	134	1927					
1879	175	1917	3,674	1919				1903	112	1929	28	1931			
1881	242	1886	896	1924	1,926	1925		1905	43	1908	1,840	1916			
1883	421	1922						1906	2,034	1932					
1885	497	1895	485	1904	628	1910		1907	2,399	1932					
	12	1911	120	1923	86	1931		1908	534	1931					
1886	242	1896	293	1916				1909	36	1917	52	1919			
1888	332	1904						1910	85	1926					
1889	896	1901	1,088	1904	901	1905		1911	107	1915	860	1916	1	1931	
	1,365	1906	297	1907	32	1909		1912	67	1918					
	3,443	1925	577	1926				1913	30	1914	85	1916			
1891	439	1904	586	1925	540	1926		1914	9	1914	80	1929			
	14	1931						1915	922	1927					
1892	1,389	1904	539	1906	1,060	1924		1920	60	1927					
	34	1925						1921	80	1927					
1893	48	1925	5	1926	4	1930		1922	70	1923	219	1931			
	88	1931						1924	104	1929					
1894	262	1896	468	1899	219	1925		1925	12	1925					
	196	1935						1926	305	1926	291	1930			
1895	1,260	1898	497	1900	907	1901									

16-IN. CAST-IRON UNLINED MAINS

Year				Year			
Installed	Feet			Installed	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1829	1,046	936	110	1868	1,284	1,284	0
1830	447	400	47	1871	8,908	8,826	82
1831	1,308	1,308	0	1872	1,573	1,573	0
1832	1,338	1,338	0	1873	5,872	5,872	0
1834	2,131	2,131	0	1874	12	12	0
1836	1,471	1,420	51	1875	828	828	0
1844	1,338	1,338	0	1877	175	175	0
1845	17,311	14,489	2,822	1879	12	12	0
1848	1,725	1,674	51	1881	179	179	0
1850	1,288	1,288	0	1882	536	536	0
1858	4,681	4,681	0	1884	16,126	15,926	200
1859	2,235	2,235	0	1885	2,966	2,966	0
1867	1,170	1,170	0	1886	1,065	1,065	0

16-IN. CAST-IRON UNLINED MAINS (contd.)

Year				Year			
		Feet				Feet	
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1887	1,297	1,297	0	1911	1,110	1,110	0
1888	6,329	6,275	54	1913	963	963	0
1889	376	376	0	1914	1,818	1,818	0
1890	446	446	0	1915	10,951	10,951	0
1891	4,084	4,084	0	1916	10	10	0
1892	144	144	0	1919	5,104	5,104	0
1893	561	543	18	1920	882	882	0
1894	8,881	8,877	4	1921	6,748	6,748	0
1895	61	56	5	1922	13,697	13,293	404
1896	8,405	8,314	91	1923	901	901	0
1897	8,938	8,938	0	1924	6,209	6,209	0
1898	2,042	2,042	0	1925	9,469	9,469	0
1899	2,872	2,872	0	1926	24,641	24,641	0
1900	9,393	9,393	0	1927	3,967	3,967	0
1901	1,929	1,929	0	1928	147	147	0
1902	27	27	0	1929	358	358	0
1903	12,396	12,396	0	1930	1,338	1,338	0
1904	2,687	2,687	0	1931	550	550	0
1905	5,974	5,959	15	1932	3,107	3,107	0
1906	13,302	13,180	122	1933	1,194	1,194	0
1907	11,333	11,333	0	1934	143	143	0
1908	7,616	7,616	0	1940	0	0	0
1909	4,123	4,123	0				
1910	7,255	7,255	0	TOTAL	290,803	286,727	4,076

Retirements by Years

Year							Year						
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1829	110	1928					1888	54	1932				
1830	47	1925					1893	18	1932				
1836	51	1928					1894	4	1917				
1845	1,170	1867	1,286	1887	267	1892	1895	5	1895				
	99	1926					1896	20	1916	71	1932		
1848	51	1928					1905	15	1908				
1871	82	1894					1906	122	1929				
1884	200	1925					1922	404	1926				

18-IN. CAST-IRON UNLINED MAINS

Year				Year			
		Feet				Feet	
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1890	2,021	2,021	0	1940	0	0	0
1905	10	10	0				
				TOTAL	2,031	2,031	0

SURVIVAL AND RETIREMENT

20-IN. CAST-IRON UNLINED MAINS

<i>Year</i>				<i>Year</i>			
<i>Installed</i>		<i>Feet</i>		<i>Installed</i>		<i>Feet</i>	
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1819	11,813	3,471	8,342	1896	6,137	6,137	0
1822	322	322	0	1897	328	328	0
1829	15,282	8,311	6,971	1898	917	917	0
1838	5,353	0	5,353	1899	1,756	1,609	147
1848	1,444	1,362	82	1900	17,906	17,556	350
1859	1,936	1,920	16	1901	6,938	6,938	0
1865	3,655	3,655	0	1903	28,994	28,490	504
1867	15,915	11,477	4,438	1904	7,892	7,614	278
1868	9,326	9,304	22	1905	1,908	1,908	0
1869	12,012	11,564	448	1906	158	158	0
1870	6,540	5,330	1,210	1907	36	36	0
1871	1,452	1,452	0	1908	1,283	1,283	0
1872	5,151	4,787	364	1915	16,631	16,631	0
1873	6,604	1,570	5,034	1918	23	23	0
1874	3,232	3,232	0	1919	426	426	0
1875	408	408	0	1920	2,220	2,220	0
1876	8,420	5,733	2,687	1921	18	18	0
1877	4,080	4,080	0	1922	7,264	7,264	0
1878	3,889	3,889	0	1925	1,288	1,288	0
1879	7,625	5,994	1,631	1926	76	76	0
1881	525	525	0	1927	35	35	0
1882	10,854	5,694	5,160	1928	2,076	2,043	33
1884	82	82	0	1929	8,120	8,120	0
1885	14,153	13,813	340	1930	1,056	1,056	0
1886	913	610	303	1931	3,639	3,639	0
1887	4,034	4,034	0	1932	4,385	4,385	0
1889	89	0	89	1934	380	380	0
1891	18,668	18,668	0	1935	148	148	0
1892	771	771	0	1939	339	339	0
1893	26,132	26,076	56	1940	0	0	0
1894	2,984	2,984	0				
1895	370	370	0	TOTAL	326,411	282,553	43,858

Retirements by Years

<i>Year</i>						<i>Year</i>					
<i>Installed Feet</i>		<i>Year</i>		<i>Feet</i>		<i>Installed Feet</i>		<i>Year</i>		<i>Feet</i>	
1819	1,149	1872	7,193	1928		1879	399	1898	700	1913	532
1829	78	1906	6,893	1918		1882	160	1908	5,000	1927	
1838	3,387	1928	1,966	1929		1885	205	1908	50	1926	35
1848	82	1932					50	1935			
1859	16	1932				1886	303	1918			
1867	614	1886	1,683	1901	2,141	1889	89	1901			
1868	22	1896				1893	38	1908	18	1932	
1869	448	1908				1899	147	1899			
1870	40	1896	1,170	1899		1900	250	1905	100	1931	
1872	194	1908	170	1934		1903	504	1927			
1873	5,034	1932				1904	278	1935			
1876	2,687	1921				1928	33	1929			

22-IN. CAST-IRON UNLINED MAINS

<i>Year</i> <i>Installed</i>	<i>Feet</i>			<i>Retirements by Years</i>				
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Year</i> <i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1819	2,660	0	2,660	1819	1,578	1897	1,082	1898
1940	0	0	0					
TOTAL	2,660	0	2,660					

24-IN. CAST-IRON UNLINED MAINS

<i>Year</i> <i>Installed</i>	<i>Feet</i>			<i>Year</i> <i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1871	564	564	0	1928	433	433	0
1885	2	2	0	1930	17,598	17,598	0
1897	1,588	1,578	10	1931	674	674	0
1898	523	523	0	1934	544	544	0
1904	9,245	9,245	0	1935	98	98	0
1914	194	194	0	1940	0	0	0
1915	1,478	1,478	0				
1919	17	17	0	TOTAL	119,523	119,450	73
1920	308	308	0				
1922	11,622	11,622	0	<i>Retirements by Years</i>			
1924	10,895	10,895	0	<i>Year</i>			
1925	22,378	22,315	63	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1926	26,192	26,192	0	1897	10	1898	
1927	15,170	15,170	0	1925	63	1931	

30-IN. CAST-IRON UNLINED MAINS

<i>Year</i> <i>Installed</i>	<i>Feet</i>			<i>Year</i> <i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1819	44	0	44	1889	4,733	4,733	0
1850	14,024	11,420	2,604	1891	10,790	9,831	959
1851	1,763	1,763	0	1892	6,821	6,665	156
1852	7,960	6,409	1,551	1893	26,611	26,540	71
1859	17,806	7,814	9,992	1894	475	475	0
1865	834	834	0	1895	32	32	0
1866	19,109	10,636	8,473	1896	26	26	0
1867	856	376	480	1898	129	109	20
1868	4,760	4,760	0	1899	2,062	2,062	0
1870	3,800	3,800	0	1900	33,217	33,072	145
1871	7,932	7,716	216	1901	12,403	12,328	75
1872	3,111	1,698	1,413	1902	148	148	0
1874	132	132	0	1903	36,393	36,306	87
1876	11,316	9,620	1,696	1904	1,645	1,645	0
1877	7,317	7,226	91	1905	115	115	0
1878	4,187	4,187	0	1906	77	77	0
1879	6,874	6,800	74	1907	803	803	0
1881	747	725	22	1908	1,986	1,968	18
1882	2,137	2,137	0	1909	2,417	2,417	0
1884	3,226	3,226	0	1910	22	22	0
1885	614	614	0	1911	60	60	0
1886	5,145	3,905	1,240	1912	813	813	0
1887	24,756	11,365	13,391	1915	3,245	3,174	71
1888	84	84	0	1916	544	544	0

SURVIVAL AND RETIREMENT

30-IN. CAST-IRON UNLINED MAINS (contd.)

Year				Year			
		Feet				Feet	
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1918	609	609	0	1928	11	11	0
1919	42	42	0	1929	127	127	0
1920	162	162	0	1930	7,410	7,410	0
1924	408	408	0	1931	109	109	0
1925	121	121	0	1940	0	0	0
1926	426	426	0				
1927	6,304	6,304	0	TOTAL	309,830	266,941	42,889

Retirements by Years

Year						Year					
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year
1819	44	1930					1881	22	1903		
1850	1,482	1886	799	1918	190	1919	1886	813	1912	427	1916
	133	1927					1887	232	1909	12,861	1923
1852	78	1898	1,473	1913			1891	959	1909		298
1859	7,772	1927	2,220	1932			1892	156	1926		1931
1866	278	1892	20	1907	8,175	1927	1893	71	1926		
1867	480	1928					1898	20	1918		
1871	72	1884	144	1885			1900	145	1902		
1872	341	1892	312	1900	530	1907	1901	75	1901		
	230	1908					1903	87	1916		
1876	66	1901	1,630	1923			1908	18	1908		
1877	91	1925					1915	71	1932		
1879	60	1911	14	1925							

36-IN. CAST-IRON UNLINED MAINS

Year				Year			
		Feet				Feet	
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1830	116	116	0	1896	528	528	0
1869	2,136	0	2,136	1897	24	24	0
1870	10,102	8,481	1,621	1898	64	46	18
1871	11,349	11,349	0	1899	2,438	2,438	0
1872	3,752	3,752	0	1900	6,734	6,734	0
1878	32	32	0	1901	1,976	1,976	0
1881	48	48	0	1904	120	96	24
1882	158	158	0	1906	2,250	2,250	0
1884	3,956	3,956	0	1908	23	23	0
1885	11,435	11,435	0	1913	143	143	0
1886	6,994	6,493	501	1916	61	61	0
1887	228	21	207	1918	685	685	0
1888	199	141	58	1922	10,096	10,096	0
1889	4,208	4,186	22	1926	16,306	16,306	0
1890	323	323	0	1927	160	160	0
1891	9,581	9,520	61	1928	322	322	0
1892	1,942	1,897	45	1940	0	0	0
1893	5,392	5,392	0				
1894	479	479	0	TOTAL	114,653	109,960	4,693
1895	293	293	0				

36-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years

<i>Year</i>							<i>Year</i>						
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1869	2,136	1928					1889	22	1902				
1870	206	1884	963	1886	452	1890	1891	61	1916				
1886	501	1918					1892	45	1892				
1887	207	1893					1898	18	1918				
1888	58	1895					1904	24	1907				

48-IN. CAST-IRON UNLINED MAINS

<i>Year</i>				<i>Year</i>			
<i>Installed</i>	<i>Feet</i>			<i>Installed</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1861	21	0	21	1903	11,046	10,906	140
1865	1,104	0	1,104	1904	5,782	5,782	0
1866	3,871	3,326	545	1906	15,809	12,141	3,668
1876	4,145	4,145	0	1907	620	620	0
1882	2,606	2,606	0	1909	1,197	1,197	0
1883	970	970	0	1912	14,180	14,180	0
1884	856	856	0	1914	2,018	2,018	0
1885	204	204	0	1915	31,952	31,952	0
1886	16,399	13,391	3,008	1916	4,632	4,632	0
1887	4,112	3,980	132	1917	6,137	6,137	0
1888	2,103	2,103	0	1919	42	0	42
1889	2,008	2,008	0	1920	393	393	0
1890	15,027	13,563	1,464	1921	8,597	8,597	0
1891	6,848	6,453	395	1925	1,011	1,011	0
1892	521	521	0	1926	8,308	8,308	0
1893	23,636	18,407	5,229	1927	3,309	3,256	53
1894	39,530	39,530	0	1930	194	194	0
1895	14,294	13,032	1,262	1931	53	53	0
1896	5,931	5,931	0	1932	754	754	0
1897	209	209	0	1934	170	170	0
1898	1,645	1,603	42	1940	0	0	0
1899	9,037	9,037	0				
1900	10,816	10,816	0	TOTAL	291,740	272,666	19,074
1901	9,643	7,674	1,969				

Retirements by Years

<i>Year</i>							<i>Year</i>						
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1861	21	1899					1893	80	1898	265	1920	4,884	1921
1865	1,104	1921					1895	1,262	1900				
1866	545	1927					1898	42	1918				
1886	415	1898	163	1899	1,892	1927	1901	850	1921	1,119	1932		
	538	1930					1903	140	1927				
1887	132	1927					1906	1,985	1926	1,513	1932	170	1934
1890	1,464	1921					1919	42	1919				
1891	395	1927					1927	53	1931				

60-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1921	4,230	4,230	0
1930	600	600	0
1940	0	0	0
TOTAL	4,830	4,830	0

72-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1930	13,514	13,514	0
1940	0	0	0
TOTAL	13,514	13,514	0

93-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1930	13,150	13,150	0
1940	0	0	0
TOTAL	13,150	13,150	0

12-IN. STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1930	1,214	1,214	0
1931	1,347	1,347	0
1932	240	240	0
1940	0	0	0
TOTAL	2,801	2,801	0

16-IN. STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1935	120	120	0
1940	0	0	0
TOTAL	120	120	0

20-IN. STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1908	151	151	0
1940	0	0	0
TOTAL	151	151	0

30-IN. STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1930	1,138	1,138	0
1931	75	75	0
1932	377	377	0
1940	0	0	0
TOTAL	1,590	1,590	0

36-IN. STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1921	850	850	0
1927	164	164	0
1940	0	0	0
TOTAL	1,014	1,014	0

48-IN. STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1901	48	48	0
1906	10,828	10,828	0
1907	3,294	3,294	0
1924	9,329	9,329	0
1926	288	288	0
1927	6,303	6,303	0
1932	1,729	1,729	0
1940	0	0	0
TOTAL	31,819	31,819	0

60-IN. STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1921	2,739	2,739	0
1940	0	0	0
TOTAL	2,739	2,739	0

93-IN. STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1930	5,651	5,651	0
1940	0	0	0
TOTAL	5,651	5,651	0

Portland, Maine

As of December 31, 1940

THE Portland Water District is a public municipal corporation, created by an act of the legislature of the state of Maine, approved Mar. 27, 1907. The district supplies an area about 20 mi. square, including, besides the city of Portland, the cities of South Portland and Westbrook and the towns of Gorham, Cape Elizabeth, Windham, Scarborough, Falmouth and Cumberland. Peaks Island, formerly supplied by a private company, is now also supplied by the water district.

The district is entirely separate from the city governments of the cities served and is controlled by a board of five trustees, elected by popular vote, four from the city of Portland and one from South Portland.

Within the service territory, at the date of the study, there were 23,524 services furnishing water to an estimated 109,000 persons. Consumption during 1940 averaged 14.3 mgd., or about 131 gpd. per capita.

Development of the Existing System

Construction of the system was started in 1868 by the Portland Water Company, a private company which continued to operate the works until 1908, when the works were purchased by the district.

The source of the water supply is Sebago Lake, about 16 mi. north of Portland. This lake, with an elevation of 265 ft. above sea level, has a surface area of 45.6 sq.mi. and a drainage area of about 436 sq.mi. The water from the lake is soft, clear and unpolluted

and receives no other treatment than the application of sodium hypochlorite, commenced in 1914, and chlorine, started in 1925.

The first supply pipe laid in 1868-69 was made of sheet iron, coated and lined with natural cement, and was 20 in. in diameter. A second main, of similar construction, partly 26 in. and partly 24 in., was installed, parallel to the first main, in 1879. More than one-third of these mains were still in service at the date of the study.

In addition to the portions of the cement mains still in service, the distribution system is supplied by a 42-in. cast-iron, a 30-in. cast-iron and a 48-in. reinforced concrete transmission main, variously inter-connected and branching to parts of the system serving Portland and South Portland and, along their routes, Windham, Gorham and Westbrook.

There are two reservoirs in the system which were formerly used as equalizing reservoirs on the low service but are now kept filled for reserve.

Bramhall Reservoir, located in the southwestern part of the city, was constructed in 1868 in excavation and earth embankment, with sides lined with masonry and the bottom with clay. It has a capacity of 8 mil.gal. Munjoy Reservoir, of similar construction, located in the southeastern part of the city was built in 1888 and has a capacity of 20 mil.gal.

In addition there are twelve standpipes in the system, the first being built in 1892. All standpipes built in the

system are still in service except one of reinforced concrete.

The distribution system contains approximately 425 mi. of mains, from $\frac{1}{2}$ to 36 in. in diameter, 3,361 valves and 2,056 hydrants. The services are 50 per cent metered, with 11,744 meters in service.

The greater part of the mains consists of tar-coated, bell-and-spigot cast-

iron pipe laid in a 5-ft. trench. The older service pipes are largely galvanized steel, about one-half of which have been replaced recently with copper.

Basis of Study

The records of the installation and retirement of pipe were very well kept by the company which built and operated the water works from 1869 to

TABLE 1
SUMMARY OF MAINS
PORTLAND, MAINE

Size, in.	Kind	No. of Feet Installed	Percent- age of Total	No. of Feet Retired	Percent- age of Total	No. of Feet in Service	Percent- age of Total	Year of First In- stallation	Average Age, yr.
4	Cast-iron unlined	39,128	2.0	14,325	5.1	24,803	1.5	1869	51.7
6		623,014	32.2	106,250	38.0	516,764	31.3	1869	31.8
8		375,227	19.4	42,707	15.3	332,520	20.1	1869	23.4
10		38,752	2.0	1,551	0.5	37,201	2.3	1869	34.5
12		157,926	8.2	8,599	3.1	149,327	9.0	1869	37.0
16		31,163	1.6	6,790	2.4	24,373	1.5	1869	38.4
20		43,404	2.2	521	0.2	42,883	2.6	1887	26.8
24		3,622	0.2	176	0.1	3,446	0.2	1879	24.4
30		34,728	1.8	4,133	1.5	30,595	1.9	1900	38.8
42		75,749	3.9	0	0	75,749	4.6	1912	28.5
48	134	0.0	0	0	134	0.0	1925	15.5	
6	Cast-iron cement-lined	59,017	3.1	141	0.0	58,876	3.6	1925	10.8
8		104,825	5.4	18	0.0	104,807	6.3	1926	11.6
10		320	0.0	0	0	320	0.0	1928	11.6
12		49,644	2.6	0	0	49,644	3.0	1927	11.8
16		19,666	1.0	0	0	19,666	1.2	1926	11.3
20		9,571	0.5	0	0	9,571	0.6	1926	11.2
24		12,722	0.7	0	0	12,722	0.8	1927	10.9
30		5,355	0.3	0	0	5,355	0.3	1927	13.5
8		15,229	0.8	0	0	15,229	0.9	1939	1.5
12		8,641	0.4	0	0	8,641	0.5	1939	1.5
16	Cast-iron bituminous- lined	4,330	0.2	0	0	4,330	0.3	1939	1.5
30		3,942	0.2	0	0	3,942	0.2	1939	1.5
42	Concrete	13,596	0.7	0	0	13,596	0.8	1931	9.5
48		53,202	2.8	0	0	53,202	3.2	1931	3.8
36	Steel	3,730	0.2	0	0	3,730	0.2	1931	9.5
20	Wrought-iron cement-lined	72,698	3.8	47,469	17.0	25,229	1.5	1869	71.5
24		55,632	2.9	36,253	12.9	19,379	1.2	1879	61.5
26		18,072	0.9	10,872	3.9	7,200	0.4	1879	61.5
TOTAL		1,933,039	100.0	279,805	100.0	1,653,234	100.0		27.0
Percentage of Total		100.00		14.47		85.53			
Average Size, in.		12.70		12.53		12.73			

TABLE 1 (contd.)
Mortality Survival Ratios

Size, in.	Kind	Number of Feet	Period Covered, yr.	Percentage
4	Cast-iron unlined	39,128	71.5	48.489
6		623,014	70.5	68.057
8		375,227	58.5	77.479
10 and 12		196,678	62.5	92.341
Over 12		188,800	61.5	90.668
6	Cast-iron cement-lined	59,017	15.5	99.761
8		104,825	14.5	99.983
10-30		97,278	14.5	100.000
8-16	Cast-iron bituminous-lined	28,200	1.5	100.000
30-48	Concrete	70,740	9.5	100.000
36	Steel	3,730	9.5	100.000
20-26	Wrought-iron cement-lined	146,402	71.5	25.080
TOTAL		1,933,039		

TABLE 2
SUMMARY OF METERS
PORTLAND, MAINE

Size, in.	Kind	Number Installed	Number Identified	Number Retired	Number in Service	Average Age, yr.
$\frac{3}{8}$	Piston	4	4	1	3	8.5
$\frac{5}{8}$		9,025	9,004	99	8,905	17.2
$\frac{3}{4}$		515	511	18	493	24.8
1		305	303	12	291	21.6
$1\frac{1}{2}$		183	182	5	177	21.0
2		371	365	32	333	18.5
3		13	13	1	12	20.6
4		12	12	3	9	13.6
$\frac{5}{8}$		714	685	642	43	16.7
$\frac{3}{4}$		62	61	60	1	37.5
1	Disc	9	8	8	0	—
$1\frac{1}{2}$		4	4	4	0	—
2		15	14	13	1	28.5
3		2	1	1	0	—
4		3	2	1	1	21.5
6		5	3	2	1	29.5
8		4	3	1	2	28.5
12		2	1	1	0	—
3	Compound	1	1	0	1	15.5
4		9	9	0	9	17.1
6		6	6	0	6	5.5
8		4	4	0	4	14.8
2	Current	31	31	16	15	26.9
3		4	3	0	3	45.8
4		11	11	3	8	39.3
6		7	7	1	6	36.0
TOTAL		11,321	11,248	924	10,324	17.8

TABLE 2 (contd.)
Mortality Survival Ratios

Size, in.	Kind	Number	Period Covered, yr.	Percentage
$\frac{3}{4}$ and $\frac{5}{8}$	Piston	9,008	49.5	97.640
$\frac{3}{4}$ -4	Piston	1,386	46.5	91.174
$\frac{5}{8}$	Disc	685	38.5	0.859
$\frac{1}{4}$ -12	Disc	97	37.5	1.531
2-8	Compound and Current	72	52.5	55.569
TOTAL		11,248		

1908 and these records were continued under the present management. The pipe record books show the location, date and size of each section of pipe installed and retired.

The record of meter installation and retirement is substantially complete from the date of the first installation.

The records of the installation and retirement of valves, hydrants and services are not complete. Generally valves were installed and retired with the pipe in which located, but details are not available.

Mortality Survival Study

Mortality studies were made of mains and meters. Table 1 is a summary of the pipe installed, the amount retired and that still in service, as well as other pertinent data. Figure 1 shows the mortality survival curves

covering the record of the mains grouped as shown.

Table 2 is a summary of the installation and retirement of meters, with Figure 2 representing the applicable mortality curves.

Given below is a summary of the standpipes and elevated tanks which have been erected in the system.

Causes of Retirement

The causes of retirement of mains were not determined in the study.

Acknowledgment

The collection and compilation of data in Portland were under the general supervision of Harry U. Fuller, Chief Engineer of the District and a member of the Committee on Survival and Retirement Experience With Water Works Facilities.

SUMMARY OF STANDPIPES AND TANKS PORTLAND, MAINE

South Portland—Open wrought-iron standpipe, 36 ft. in diameter, 77 ft. high; capacity 602,000 gal. Erected in 1892 and still in service.

Gorham—Open steel standpipe, 35 ft. in diameter, 50 ft. high; capacity 360,000 gal. Erected in 1896 and still in service.

Portland—Munjoy Hill—Open steel standpipe, 40 ft. in diameter, 75 ft. high; capacity 653,000 gal. Erected in 1904 and still in service.

Peaks Island—Open concrete standpipe, 28 ft. in diameter, 40 ft. high; capacity 175,000 gal. Erected in 1909 and retired 1934 because of disintegration of concrete.

Peaks Island—Open steel standpipe, replacing above, 40 ft. in diameter, 50 ft. high; capacity 470,000 gal. Erected in 1934 and still in service.

Falmouth Foreside—Open steel standpipe, 40 ft. in diameter, 55 ft. high; capacity 517,000 gal. Erected in 1923 and still in service.

Prouts Neck—Open steel standpipe, 15 ft. in diameter, 50 ft. high; capacity 66,000 gal. Erected in 1902 and still in service.

Scarboro (Oak Hill)—Open steel standpipe, 35 ft. in diameter, 90 ft. high; capacity 646,000 gal. Erected in 1926 and still in service.

Scarboro (Dunstan)—Open steel standpipe, 25 ft. in diameter, 70 ft. high; capacity 258,000 gal. Erected in 1929 and still in service.

Great Diamond Island—Open, steel standpipe, 30 ft. in diameter, 25 ft. high; capacity 132,500 gal. Erected in 1900 and still in service.

Newhall (South Windham)—Open steel standpipe, 30 ft. in diameter, 45 ft. high;

capacity 237,800 gal. Erected in 1938 and still in service.

Westbrook (Brook Street)—Open, steel standpipe, 30 ft. in diameter, 55 ft high; capacity 290,000 gal. Erected in 1939 and still in service.

North Windham (Halls Point)—Open steel standpipe, 12 ft. in diameter, 12 ft. high; capacity 10,000 gal. Erected in 1939 and still in service.

North Windham—Elliptical bottom, covered elevated steel tank, 32 ft. in diameter, 23 ft. high, on tower; capacity 200,000 gal. Erected in 1938 and still in service.

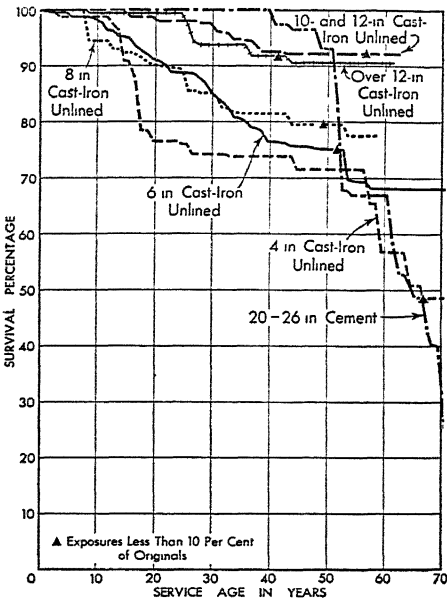


FIG. 1. Mortality Survival Curve—4-48-in. Cast-Iron Unlined and 20-26-in. Wrought-Iron Cement-Lined Mains—Portland, Maine

BASE: Feet		SURVIVAL: 1869-1940	
SIZE	KIND	EXPOSURES	RETIREMENTS
in.		ft.	ft.
4	Cast-Iron	39,128	14,325
6		623,014	106,250
8		375,227	42,707
10 and 12	Unlined	196,678	10,150
Over 12		188,800	11,620
20-26	Wrought-Iron Cement-Lined	146,402	94,594

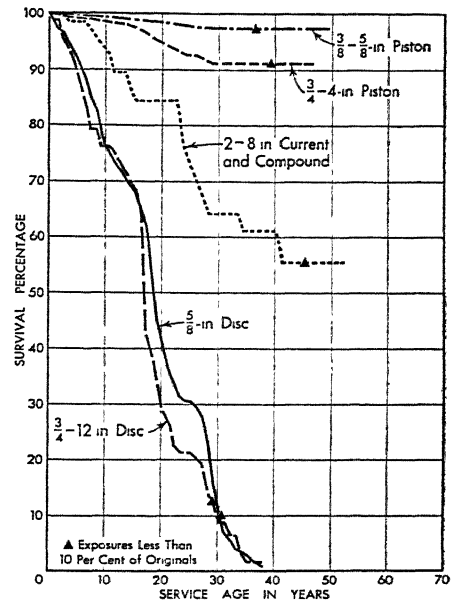


FIG. 2. Mortality Survival Curve— $\frac{3}{8}$ -12-in. Meters—Portland, Maine

BASE: Unit		SURVIVAL: 1886-1940	
SIZE	KIND	EXPOSURES	RETIREMENTS
in.		Units	Units
$\frac{3}{8}$ and $\frac{5}{8}$	Piston	9,008	100
$\frac{3}{4}$ -4	Piston	1,386	71
$\frac{5}{8}$	Disc	685	642
$\frac{3}{4}$ -12	Disc	97	91
2-8	Current and Compound	72	20

SUMMARY OF INSTALLATIONS AND RETIREMENTS

PORTLAND, MAINE

MAINS

4-IN. CAST-IRON UNLINED MAINS

Year				Year			
		Feet				Feet	
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1869	6,725	46	6,679	1896	94	94	0
1870	1,948	1,088	860	1900	384	384	0
1871	2,176	640	1,536	1901	392	392	0
1873	2,086	987	1,099	1904	801	136	665
1874	1,455	1,210	245	1905	19	19	0
1875	2,239	1,462	777	1906	360	360	0
1877	1,088	464	624	1908	45	45	0
1878	940	716	224	1909	87	87	0
1879	1,115	1,115	0	1910	649	649	0
1880	669	669	0	1911	511	511	0
1881	828	828	0	1913	184	184	0
1882	160	160	0	1917	470	470	0
1883	825	44	781	1920	31	31	0
1884	518	518	0	1921	1,043	1,043	0
1885	2,205	2,205	0	1928	25	25	0
1886	4,410	3,665	745	1930	123	123	0
1887	245	245	0	1932	699	699	0
1889	480	480	0	1940	0	0	0
1890	75	75	0				
1891	610	610	0	SUBTOTAL	39,128	24,803	14,325
1892	1,711	1,711	0	Unknown	12,763	12,763	0
1894	423	423	0				
1895	280	190	90	TOTAL	51,891	37,566	14,325

Retirements by Years

Year				Year			
Installed Feet		Year		Installed Feet		Year	
1869	1,329	1883	1,173	1877	624	1889	
	657	1888		1878	224	1902	
1870	134	1914	412	1883	104	1915	677
1871	1,536	1930		1886	475	1889	270
1873	54	1889	1,045	1895	90	1912	
1874	42	1931	203	1904	665	1930	
1875	777	1889					

6-IN. CAST-IRON UNLINED MAINS

Year				Year			
		Feet				Feet	
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1869	23,107	0	23,107	1879	4,758	2,896	1,862
1870	7,362	1,380	5,982	1880	787	246	541
1871	4,665	4,496	169	1881	4,076	2,630	1,446
1872	12	12	0	1883	1,211	1,099	112
1873	2,405	1,103	1,302	1884	507	507	0
1874	1,605	1,012	593	1885	8,764	3,429	5,335
1877	4,704	3,829	875	1886	24,397	13,378	11,019
1878	308	308	0	1887	7,400	7,109	291

6-IN. CAST-IRON UNLINED MAINS (contd.)

Feet				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1888	9,723	9,723	0	1917	11,203	11,011	192
1889	22,344	19,890	2,454	1918	1,821	1,821	0
1890	5,303	4,321	982	1919	1,338	1,338	0
1891	3,751	3,576	175	1920	3,913	3,913	0
1892	31,823	28,609	3,214	1921	14,335	14,335	0
1893	3,347	1,859	1,488	1922	6,588	6,588	0
1894	5,673	4,594	1,079	1923	2,688	2,688	0
1895	16,880	15,200	1,680	1924	6,830	6,830	0
1896	14,726	13,195	1,531	1925	17,318	17,318	0
1897	24,161	19,393	4,768	1926	1,053	1,015	38
1898	22,764	16,267	6,497	1927	531	531	0
1899	11,621	4,215	7,406	1928	1,434	1,434	0
1900	4,647	3,052	1,595	1929	107	107	0
1901	16,539	14,853	1,686	1930	234	234	0
1902	21,807	20,652	1,155	1931	12,540	12,540	0
1903	2,252	2,160	92	1932	1,270	1,270	0
1904	9,822	9,144	678	1933	304	304	0
1905	5,088	4,511	577	1934	6,371	6,371	0
1906	10,628	9,094	1,534	1935	8,569	8,569	0
1907	4,436	3,373	1,063	1936	9,526	9,526	0
1908	4,349	4,308	41	1937	10,242	10,242	0
1909	6,685	6,685	0	1938	19,164	19,164	0
1910	3,125	2,875	250	1939	8,911	8,911	0
1911	10,970	5,356	5,614	1940	5,198	5,198	0
1912	13,154	11,789	1,365	SUBTOTAL	623,014	516,764	106,250
1913	21,480	18,791	2,689	Unknown	13,404	13,404	0
1914	15,872	13,248	2,624				
1915	33,962	33,917	45				
1916	18,526	17,422	1,104	TOTAL	636,418	530,168	106,250

Retirements by Years

Year				Year			
Installed	Feet	Year	Feet	Installed	Feet	Year	Feet
1869	90	1883	877	1886	200	1940	
	4,966	1886	1,303	1887	235	1903	56
	3,046	1891	26	1889	234	1904	888
	596	1898	1,281	1890	458	1922	524
	2,699	1902	381	1891	175	1902	
	280	1911		1892	3,214	1931	
1870	4,010	1889	256	1893	326	1921	1,162
	408	1902	306	1894	243	1904	313
1871	108	1891	61	1895	139	1901	1,541
1873	987	1881	315	1896	550	1927	981
1874	220	1900	373	1897	200	1902	268
1877	875	1930		1898	2,415	1911	476
1879	934	1889	928		1,958	1931	754
1880	196	1891	345	1899	5,420	1904	1,896
1881	250	1891	1,196	1900	1,595	1939	
1883	112	1903		1901	415	1918	1,271
1885	5,335	1896		1902	445	1912	247
1886	506	1900	630		68	1930	
	1,136	1914	4,343	1903	92	1931	
	251	1930	141	1904	103	1930	575
						1931	

6-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year							Year						
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1905	450	1912	127	1922			1913	231	1935				
1906	1,534	1928					1914	349	1916	289	1926	1,902	1927
1907	490	1925	573	1927				39	1928	45	1930		
1908	41	1928					1915	45	1928				
1910	250	1927					1916	486	1927	618	1937		
1911	3,384	1922	2,230	1927			1917	192	1930				
1912	870	1922	495	1939			1926	38	1939				
1913	651	1914	134	1930	1,673	1931							

8-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1869	9,544	0	9,544	1916	8,486	8,486	0
1870	422	0	422	1917	3,910	3,379	531
1882	194	194	0	1918	2,278	2,278	0
1883	1,652	1,652	0	1919	1,334	1,334	0
1885	2,720	2,720	0	1920	1,089	1,089	0
1886	20,264	11,557	8,707	1921	13,413	13,413	0
1887	3,640	3,640	0	1922	11,340	11,340	0
1889	7,877	7,877	0	1923	6,531	6,531	0
1891	2,919	2,919	0	1924	7,268	7,268	0
1892	34,862	14,334	20,528	1925	11,460	11,460	0
1893	600	600	0	1926	449	449	0
1894	189	0	189	1927	1,089	1,089	0
1895	14,793	14,793	0	1928	5,646	5,646	0
1896	390	390	0	1929	2,359	2,359	0
1897	29	29	0	1930	5,162	5,162	0
1900	6,532	4,601	1,931	1931	875	875	0
1901	5,337	5,337	0	1933	630	630	0
1902	6,619	6,619	0	1934	5,045	5,045	0
1903	1,294	1,294	0	1935	3,569	3,569	0
1904	10,272	9,890	382	1936	35,367	35,367	0
1905	2,980	2,980	0	1937	7,280	7,280	0
1906	3,634	3,634	0	1938	21,846	21,846	0
1907	90	0	90	1939	12,306	12,306	0
1908	461	461	0	1940	5,862	5,862	0
1909	1,933	1,933	0				
1912	9,489	9,343	146	SUBTOTAL	375,227	332,520	42,707
1913	10,455	10,455	0	Unknown	32,848	32,848	0
1914	1,942	1,942	0				
1915	39,500	39,263	237	TOTAL	408,075	365,368	42,707

Retirements by Years

Year						Year							
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1869	1,476	1883	967	1885	1,444	1886	1894	189	1904				
	2,382	1887	127	1888	332	1889	1900	841	1922	1,090	1931		
	600	1893	390	1896	859	1900	1904	382	1931				
	400	1901	567	1902			1907	90	1931				
1870	422	1904					1912	146	1931				
1886	6,850	1911	1,297	1929	560	1939	1915	40	1922	197	1932		
1892	15,468	1900	3,730	1904	1,330	1922	1917	531	1930				

10-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>			
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	
1869	1,551	0	1,551	1922	2,426	2,426	0	
1881	508	508	0	1923	560	560	0	
1883	1,405	1,405	0	1940	0	0	0	
1884	16	16	0					
1889	10	10	0	TOTAL	38,752	37,201	1,551	
1895	382	382	0					
1897	22	22	0					
1900	20	20	0					
1906	31,848	31,848	0					
1915	4	4	0					

<i>Year</i>	<i>Retirements by Years</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1869	1,306	1889	245	1899

12-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1869	4,577	0	4,577	1904	10,718	10,718	0
1878	2,860	2,860	0	1905	84	84	0
1879	5,234	5,234	0	1906	949	949	0
1881	2,280	2,280	0	1911	12,447	12,447	0
1883	2,877	2,877	0	1912	1,836	1,836	0
1884	3,874	3,874	0	1915	4,624	3,263	1,361
1885	5,889	4,288	1,601	1918	1,741	1,741	0
1886	3,875	3,875	0	1919	3,517	3,517	0
1887	1,960	1,960	0	1922	12,547	12,547	0
1888	476	26	450	1923	989	989	0
1889	7,480	7,080	400	1924	7,687	7,687	0
1890	1,462	1,462	0	1925	694	694	0
1891	3,610	3,610	0	1926	1,906	1,906	0
1892	288	288	0	1927	102	102	0
1894	391	391	0	1928	3,543	3,543	0
1895	158	158	0	1932	14	14	0
1896	7,072	6,862	210	1937	1,821	1,821	0
1897	6,439	6,439	0	1938	575	575	0
1899	2,636	2,636	0	1939	1,385	1,385	0
1900	21,842	21,842	0	1940	210	210	0
1902	3,696	3,696	0				
1903	1,561	1,561	0	TOTAL	157,926	149,327	8,599

Retirements by Years

[illegible]

16-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet		
	Installed	In Service	Retired
1869	6,052	0	6,052
1888	7,325	7,325	0
1889	869	869	0
1895	4,100	4,100	0
1900	1,355	1,355	0
1904	1,091	1,091	0
1912	4,920	4,920	0
1917	40	40	0
1922	4,947	4,209	738
1926	94	94	0
1930	370	370	0
1940	0	0	0
TOTAL	31,163	24,373	6,790

Retirements by Years

Year Installed	Feet	Year	Feet	Year
1869	5,087	1895	965	1905
1922	738	1930		

20-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet		
	Installed	In Service	Retired
1887	750	750	0
1890	160	160	0
1903	85	85	0
1904	1,650	1,650	0
1912	15,355	14,834	521
1914	13,033	13,033	0
1915	4,411	4,411	0
1917	192	192	0
1919	847	847	0
1920	448	448	0
1921	6,149	6,149	0
1929	324	324	0
1940	0	0	0
TOTAL	43,404	42,883	521

Retirements by Years

Year Installed	Feet	Year
1912	521	1939

24-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet		
	Installed	In Service	Retired
1879	130	130	0
1884	176	0	176
1890	50	50	0
1901	157	157	0
1919	3,049	3,049	0
1931	60	60	0
1940	0	0	0
TOTAL	3,622	3,446	176

Retirements by Years

Year Installed	Feet	Year
1884	176	1927

30-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet		
	Installed	In Service	Retired
1900	26,726	26,726	0
1902	4,133	0	4,133
1912	3,623	3,623	0
1925	84	84	0
1931	10	10	0
1939	152	152	0
1940	0	0	0
TOTAL	34,728	30,595	4,133

Retirements by Years

Year Installed	Feet	Year
1902	4,133	1927

42-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet		
	Installed	In Service	Retired
1912	75,711	75,711	0
1925	38	38	0
1940	0	0	0
TOTAL	75,749	75,749	0

48-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	134	134	0
1940	0	0	0
TOTAL	134	134	0

6-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	4,211	4,211	0
1926	8,592	8,592	0
1927	6,307	6,307	0
1928	2,771	2,771	0
1929	5,186	5,186	0
1930	5,480	5,480	0
1931	571	571	0
1932	13,630	13,630	0
1933	10,439	10,439	0
1934	1,706	1,565	141
1935	124	124	0
1940	0	0	0
TOTAL	59,017	58,876	141

Retirements by Years

Year	Feet	Year
Installed		
1934	141	1939

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	15,680	15,662	18
1927	23,593	23,593	0
1928	11,527	11,527	0
1929	12,189	12,189	0
1930	12,871	12,871	0
1931	15,066	15,066	0
1932	8,325	8,325	0
1933	4,828	4,828	0
1934	223	223	0
1935	523	523	0
1940	0	0	0
TOTAL	104,825	104,807	18

Retirements by Years

Year	Feet	Year
Installed		
1926	18	1927

10-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1928	44	44	0
1929	276	276	0
1940	0	0	0
TOTAL	320	320	0

12-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	22,894	22,894	0
1928	3,930	3,930	0
1929	4,700	4,700	0
1930	8,567	8,567	0
1931	6,681	6,681	0
1933	2,150	2,150	0
1934	527	527	0
1935	195	195	0
1940	0	0	0
TOTAL	49,644	49,644	0

16-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	2,658	2,658	0
1927	5,043	5,043	0
1929	399	399	0
1930	1,570	1,570	0
1931	9,996	9,996	0
1940	0	0	0
TOTAL	19,666	19,666	0

20-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	1,240	1,240	0
1927	2,205	2,205	0
1929	120	120	0
1930	1,361	1,361	0
1931	4,456	4,456	0
1932	189	189	0
1940	0	0	0
TOTAL	9,571	9,571	0

24-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	1,848	1,848	0
1928	63	63	0
1930	10,218	10,218	0
1931	401	401	0
1932	192	192	0
1940	0	0	0
TOTAL	12,722	12,722	0

30-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	5,355	5,355	0
1940	0	0	0
TOTAL	5,355	5,355	0

8-IN. CAST-IRON BITUMINOUS-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1939	15,229	15,229	0
1940	0	0	0
TOTAL	15,229	15,229	0

12-IN. CAST-IRON BITUMINOUS-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1939	8,641	8,641	0
1940	0	0	0
TOTAL	8,641	8,641	0

16-IN. CAST-IRON BITUMINOUS-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1939	4,330	4,330	0
1940	0	0	0
TOTAL	4,330	4,330	0

30-IN. CONCRETE MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1939	3,942	3,942	0
1940	0	0	0
TOTAL	3,942	3,942	0

42-IN. CONCRETE MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	13,596	13,596	0
1940	0	0	0
TOTAL	13,596	13,596	0

48-IN. CONCRETE MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	15,126	15,126	0
1939	38,076	38,076	0
1940	0	0	0
TOTAL	53,202	53,202	0

36-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	3,730	3,730	0
1940	0	0	0
TOTAL	3,730	3,730	0

20-IN. WROUGHT-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1869	72,698	25,229	47,469
1940	0	0	0
TOTAL	72,698	25,229	47,469

Retirements by Years

Year	Feet			Year	Feet		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1869	1,206	1912	13,130	1920	5,462	1931	
	1,835	1933	7,545	1936	3,340	1937	
	14,951	1939					

24-IN. WROUGHT-IRON CEMENT-LINED
MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1879	55,632	19,379	36,253
1940	0	0	0
TOTAL	55,632	19,379	36,253

Retirements by Years

<i>Year</i>	<i>Installed Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1879	3,942	1919	5,100	1927	24,090	1931
	1,081	1933	2,040	1940		

26-IN. WROUGHT-IRON CEMENT-LINED
MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1879	18,072	7,200	10,872
1940	0	0	0
TOTAL	18,072	7,200	10,872

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>		
1879	10,872	1940

METERS

 $\frac{3}{8}$ -IN. PISTON METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1897	1	0	1
1931	1	1	0
1932	1	1	0
1933	1	1	0
1940	0	0	0
TOTAL	4	3	1

Retirements by Years

<i>Year</i>	<i>Number</i>	<i>Year</i>
<i>Installed</i>		
1897	1	1899

 $\frac{5}{8}$ -IN. PISTON METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1886	6	0	6
1888	5	0	5
1889	2	0	2
1890	3	0	3
1891	2	2	0
1892	7	3	4
1893	2	1	1
1894	1	1	0
1895	3	1	2
1896	10	9	1
1897	1	0	1
1898	93	82	11
1899	235	221	14
1900	122	116	6
1901	142	134	8
1902	55	53	2
1903	36	34	2
1904	402	399	3
1905	376	368	8
1906	96	92	4
1907	2	1	1
1908	1	1	0

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1909	1	0	1
1910	7	5	2
1911	2	1	1
1912	5	0	5
1913	2	2	0
1914	3	2	1
1915	57	57	0
1916	120	120	0
1917	84	83	1
1918	111	111	0
1919	79	79	0
1920	210	210	0
1921	143	142	1
1922	142	142	0
1923	310	310	0
1924	422	422	0
1925	397	397	0
1926	1,198	1,198	0
1927	591	589	2
1928	1,246	1,245	1
1929	391	391	0
1930	333	333	0

SURVIVAL AND RETIREMENT

 $\frac{1}{4}$ -IN. PISTON METERS (contd.)

Year				Year			
Installed	Number			Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1931	392	392	0	1939	278	278	0
1932	196	196	0	1940	238	238	0
1933	12	12	0				
1934	1	1	0	SUBTOTAL	9,004	8,905	99
1935	1	1	0	Unknown	21	0	21
1937	126	126	0				
1938	304	304	0	TOTAL	9,025	8,905	120

Retirements by Years

Year						Year					
Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Installed	Num- ber	Year	Num- ber	Year
1886	1	1905	1	1906	1	1910	1900	1	1916	1	1934
	1	1911	1	1913	1	1917	1901	2	1904	1	1913
1888	1	1893	1	1904	1	1907		1	1915	1	1918
	1	1910	1	1915			1902	1	1910	1	1913
1889	1	1906	1	1911			1903	1	1903	1	1906
1890	1	1910	1	1915	1	1916	1904	1	1905	1	1908
1892	1	1898	1	1913	1	1914	1905	1	1906	2	1907
	1	1915						1	1909	1	1910
1893	1	1909					1906	1	1906	1	1907
1895	1	1913	1	1916				1	1916		1913
1896	1	1904					1907	1	1913		
1897	1	1912					1909	1	1909		
1898	1	1901	1	1902	1	1903	1910	1	1910	1	1920
	2	1904	1	1906	1	1910	1911	1	1915		
	2	1913	1	1914	1	1916	1912	1	1914	4	1915
1899	1	1900	1	1901	1	1902	1914	1	1923		
	1	1903	3	1905	1	1906	1917	1	1921		
	2	1907	1	1911	1	1915	1921	1	1933		
	2	1917					1927	1	1930	1	1933
1900	1	1903	1	1909	2	1912	1928	1	1934		

 $\frac{3}{4}$ -IN. PISTON METERS

Year				Year			
Installed	Number			Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1886	1	0	1	1907	1	1	0
1888	3	0	3	1908	1	1	0
1889	4	0	4	1909	1	1	0
1894	3	2	1	1915	28	28	0
1895	2	2	0	1916	55	55	0
1896	3	3	0	1917	1	1	0
1897	2	0	2	1920	15	15	0
1898	25	22	3	1921	10	10	0
1899	51	49	2	1922	14	14	0
1900	25	25	0	1923	17	17	0
1901	35	35	0	1924	26	26	0
1902	33	32	1	1926	9	9	0
1903	2	2	0	1927	14	14	0
1904	7	6	1	1928	3	3	0
1905	14	14	0	1932	13	13	0
1906	2	2	0	1933	13	13	0

$\frac{3}{4}$ -IN. PISTON METERS (contd.)

Number				Number			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1934	6	6	0	1940	14	14	0
1935	10	10	0				
1936	14	14	0	SUBTOTAL	511	493	18
1937	2	2	0	Unknown	4	0	4
1938	16	16	0				
1939	16	16	0	TOTAL	515	493	22

Retirements by Years

Year	Num-	Year	Num-	Year	Num-	Year	Year	Year	Num-	Year	Num-	Year	Num-	Year
Installed	ber	Year	ber	Year	ber	Year	Year	Year	Installed	ber	Year	ber	Year	ber
1886	1	1913							1897	1	1905	1	1913	
1888	1	1904	1	1910	1	1915			1898	1	1900	1	1914	1 1916
1889	1	1906	1	1911	1	1913			1899	1	1901	1	1908	
	1	1915							1902	1	1922			
1894	1	1916							1904	1	1914			

1-IN. PISTON METERS

Number				Number			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1888	4	0	4	1921	5	5	0
1889	1	0	1	1922	13	13	0
1896	1	1	0	1923	18	18	0
1897	3	2	1	1924	14	14	0
1898	5	3	2	1925	5	5	0
1899	15	13	2	1926	17	17	0
1900	5	5	0	1927	13	13	0
1901	11	10	1	1928	6	6	0
1902	3	3	0	1929	20	20	0
1903	2	2	0	1930	5	5	0
1904	7	7	0	1932	3	3	0
1905	34	33	1	1936	12	12	0
1906	5	5	0	1937	6	6	0
1907	1	1	0	1938	7	7	0
1908	1	1	0	1939	9	9	0
1909	2	2	0	1940	16	16	0
1914	4	4	0				
1915	7	7	0	SUBTOTAL	303	291	12
1917	8	8	0	Unknown	2	0	2
1918	1	1	0				
1919	7	7	0	TOTAL	305	291	14
1920	7	7	0				

Retirements by Years

Year	Num-	Year	Num-	Year	Num-	Year	Year	Year	Num-	Year	Num-	Year	Num-	Year
Installed	ber	Year	ber	Year	ber	Year	Year	Year	Installed	ber	Year	ber	Year	ber
1888	1	1905	1	1907	1	1914			1898	1	1900	1	1911	
	1	1916							1899	1	1909	1	1912	
1889	1	1907							1901	1	1901			
1897	1	1913							1905	1	1910			

SURVIVAL AND RETIREMENT

1½-IN. PISTON METERS

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1899	2	0	2	1922	10	10	0
1900	1	0	1	1923	3	3	0
1901	4	4	0	1924	23	23	0
1902	1	1	0	1925	2	2	0
1903	2	2	0	1926	1	1	0
1904	10	9	1	1927	3	3	0
1905	11	11	0	1928	10	10	0
1906	2	2	0	1929	4	4	0
1908	5	5	0	1930	5	5	0
1909	8	8	0	1932	3	3	0
1910	5	5	0	1933	2	2	0
1913	2	1	1	1938	3	3	0
1914	4	4	0	1939	5	5	0
1915	8	8	0	1940	8	8	0
1916	5	5	0				
1917	11	11	0	SUBTOTAL	182	177	5
1918	3	3	0	Unknown	1	0	1
1919	4	4	0				
1920	9	9	0	TOTAL	183	177	6
1921	3	3	0				

Retirements by Years

Year Installed	Number	Year	Number	Year	Year Installed	Number	Year	Number	Year
1899	1	1905	1	1916	1904	1	1914		
1900	1	1913			1913	1	1913		

2-IN. PISTON METERS

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1888	2	0	2	1920	24	24	0
1896	3	0	3	1921	4	4	0
1897	3	0	3	1922	9	9	0
1898	5	0	5	1923	13	13	0
1899	7	0	7	1924	18	18	0
1900	4	0	4	1925	12	12	0
1901	4	4	0	1926	15	15	0
1902	7	5	2	1927	15	15	0
1903	3	3	0	1928	13	13	0
1904	4	4	0	1929	16	16	0
1905	7	7	0	1930	21	21	0
1906	3	2	1	1931	8	8	0
1907	3	2	1	1934	1	1	0
1909	1	1	0	1936	3	3	0
1910	8	6	2	1937	5	5	0
1911	2	2	0	1938	5	5	0
1912	1	1	0	1939	15	15	0
1913	2	0	2	1940	5	5	0
1914	13	13	0				
1915	20	20	0	SUBTOTAL	365	333	32
1916	32	32	0	Unknown	6	0	6
1917	12	12	0				
1918	6	6	0	TOTAL	371	333	38
1919	11	11	0				

2-IN. PISTON METERS (contd.)

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1888	2	1916						1900	2	1915	1	1916	1	1919
1896	1	1900	1	1916	1	1917		1902	1	1904	1	1916		
1897	1	1914	1	1918	1	1919		1906	1	1924				
1898	3	1916	1	1917	1	1919		1907	1	1907				
1899	1	1912	1	1914	3	1916		1910	1	1910	1	1925		
	1	1919	1	1920				1913	1	1916	1	1920		

3-IN. PISTON METERS

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1901	1	1	0	1935	1	1	0
1904	1	1	0	1940	1	1	0
1909	1	1	0				
1911	2	1	1	TOTAL	13	12	1
1913	1	1	0				
1921	1	1	0				
1922	1	1	0				
1924	1	1	0				
1926	1	1	0				
1933	1	1	0				

Retirements by Years

Year Installed	Number	Year
1911	1	1919

4-IN. PISTON METERS

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1896	1	0	1	1940	0	0	0
1901	1	0	1				
1904	1	0	1	TOTAL	12	9	3
1923	1	1	0				
1924	1	1	0				
1925	1	1	0				
1927	2	2	0				
1928	2	2	0				
1929	1	1	0				
1931	1	1	0				

Retirements by Years

Year Installed	Number	Year
1896	1	1919
1901	1	1919
1904	1	1927

 $\frac{5}{8}$ -IN. DISC METERS

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1891	1	0	1	1902	56	3	53
1892	2	0	2	1903	96	3	93
1893	3	0	3	1904	41	0	41
1894	4	0	4	1905	17	0	17
1895	12	0	12	1906	2	0	2
1896	12	0	12	1909	3	0	3
1897	6	0	6	1910	25	0	25
1898	1	0	1	1911	22	1	21
1899	1	0	1	1912	43	1	42
1901	3	0	3	1913	53	2	51

SURVIVAL AND RETIREMENT

 $\frac{3}{4}$ -IN. DISC METERS (contd.)

Year	Number			Year	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1914	38	3	35	1934	1	1	0
1915	100	2	98	1935	1	1	0
1916	3	1	2	1936	2	2	0
1920	24	3	21	1938	1	0	1
1921	1	0	1	1939	5	5	0
1922	1	0	1	1940	7	7	0
1923	5	0	5				
1924	76	7	69	SUBTOTAL	685	43	642
1927	2	0	2	Unknown	29	0	29
1928	3	0	3				
1929	8	1	7	TOTAL	714	43	671
1933	4	0	4				

Retirements by Years

Year	Num-		Num-		Num-		Year	Num-		Num-		Year
Installed	ber	Year	ber	Year	ber	Year	Installed	ber	Year	ber	Year	Year
1891	1	1897					1911	1	1914	1	1916	1 1923
1892	2	1898						1	1925	7	1931	2 1932
1893	1	1897	1	1899	1	1900		5	1933	2	1934	1 1935
1894	2	1895	1	1899	1	1900	1912	1	1926	18	1931	3 1932
1895	1	1899	1	1900	1	1901		15	1933	1	1934	3 1935
	1	1902	2	1903	1	1913		1	1938			
	4	1914	1	1915			1913	2	1914	1	1917	1 1918
1896	1	1898	2	1899	4	1914		1	1925	17	1931	7 1932
	1	1915	2	1916	2	1919		12	1933	7	1935	1 1939
1897	1	1898	1	1914	1	1916		2	1940			
	1	1919	2	1920			1914	1	1914	1	1915	1 1917
1898	1	1899						1	1918	4	1919	1 1920
1899	1	1902						9	1931	4	1932	10 1933
1901	1	1908	1	1915	1	1922		1	1934	1	1935	1 1938
1902	2	1905	1	1910	1	1912	1915	3	1915	1	1916	4 1918
	1	1915	1	1917	1	1918		4	1920	1	1923	1 1924
	15	1931	6	1932	12	1933		1	1926	1	1930	19 1931
	2	1934	5	1935	2	1937		9	1932	34	1933	5 1934
	3	1939	1	1940				7	1935	1	1936	2 1937
1903	2	1906	1	1907	1	1908		3	1938	2	1939	
	1	1909	1	1911	1	1914	1916	1	1918	1	1919	
	1	1917	1	1918	2	1922	1920	1	1925	4	1931	4 1932
	1	1923	1	1926	16	1931		4	1933	2	1934	2 1935
	18	1932	23	1933	4	1934		1	1936	1	1937	2 1939
	5	1935	2	1936	3	1937	1921	1	1932			
	3	1938	5	1939	1	1940	1922	1	1932			
1904	1	1911	1	1914	1	1916	1923	1	1924	1	1932	3 1933
	2	1917	1	1920	1	1926	1924	2	1928	18	1931	9 1932
	6	1931	9	1932	14	1933		24	1933	4	1934	1 1935
	3	1934	1	1935	1	1938		1	1936	4	1937	4 1938
1905	1	1905	1	1916	3	1931		2	1939			
	3	1932	3	1933	1	1935	1927	1	1927	1	1929	
	1	1936	2	1937	2	1938	1928	1	1931	2	1932	
1906	1	1932	1	1933			1929	1	1931	1	1933	1 1934
1909	1	1916	1	1919	1	1920		1	1935	1	1937	1 1938
1910	2	1915	3	1916	2	1918		1	1939			
	6	1919	2	1920	1	1922	1934	1	1933	1	1934	1 1936
	1	1928	6	1931	1	1933		1	1937			
	1	1935					1938	1	1938			

$\frac{3}{4}$ -IN. DISC METERS

Year Installed	Number		
	Installed	In Service	Retired
1891	1	0	1
1892	1	0	1
1893	1	0	1
1903	11	1	10
1905	4	0	4
1911	1	0	1
1912	2	0	2
1913	2	0	2
1916	35	0	35
1917	3	0	3
1940	0	0	0
<hr/>			
SUBTOTAL	61	1	60
Unknown	1	0	1
<hr/>			
TOTAL	62	1	61

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1891	1	1895				
1892	1	1897				
1893	1	1904				
1903	4	1931	1	1932	1	1933
	2	1935	1	1937	1	1938
1905	1	1931	1	1932	1	1934
	1	1935				
1911	1	1931				
1912	1	1931	1	1932		
1913	1	1919	1	1920		
1916	1	1916	1	1928	9	1931
	2	1932	13	1933	4	1935
	1	1936	1	1937	3	1938
1917	1	1935	1	1938	1	1940

1-IN. DISC METERS

Year Installed	Number		
	Installed	In Service	Retired
1885	1	0	1
1897	2	0	2
1898	2	0	2
1899	1	0	1
1913	2	0	2
1940	0	0	0
<hr/>			
SUBTOTAL	8	0	8
Unknown	1	0	1
<hr/>			
TOTAL	9	0	9

1-IN. DISC METERS (contd.)

Retirements by Years

Year Installed	Number	Year	Number	Year
1885	1	1889		
1897	1	1899	1	1903
1898	1	1901	1	1932
1899	1	1902		
1913	1	1920	1	1931

 $1\frac{1}{2}$ -IN DISC METERS

Year Installed	Number		
	Installed	In Service	Retired
1889	1	0	1
1895	1	0	1
1913	2	0	2
1940	0	0	0
<hr/>			
TOTAL	4	0	4

Retirements by Years

Year Installed	Number	Year	Number	Year
1889	1	1898		
1895	1	1900		
1923	1	1931	1	1935

2-IN. DISC METERS

Year Installed	Number		
	Installed	In Service	Retired
1889	1	0	1
1890	1	0	1
1891	1	0	1
1892	1	0	1
1896	1	0	1
1911	1	0	1
1912	2	1	1
1913	3	0	3
1914	2	0	2
1917	1	0	1
1940	0	0	0
<hr/>			
SUBTOTAL	14	1	13
Unknown	1	0	1
<hr/>			
TOTAL	15	1	14

2-IN. DISC METERS (contd.)

Retirements by Years

Year Installed	Number	Year	Number	Year
1889	1	1903		
1890	1	1903		
1891	1	1905		
1892	1	1904		
1896	1	1902		
1911	1	1916		
1912	1	1916		
1913	1	1922	2	1933
1914	2	1916		
1917	1	1933		

3-IN. DISC METERS

Year Installed	Number		
	Installed	In Service	Retired
1914	1	0	1
1940	0	0	0
SUBTOTAL	1	0	1
Unknown	1	0	1
TOTAL	2	0	2

Retirements by Years

Year Installed	Number	Year
1914	1	1920

4-IN. DISC METERS

Year Installed	Number		
	Installed	In Service	Retired
1915	1	0	1
1919	1	1	0
1940	0	0	0
SUBTOTAL	2	1	1
Unknown	1	0	1
TOTAL	3	1	2

Retirements by Years

Year Installed	Number	Year
1915	1	1922

6-IN. DISC METERS

Year Installed	Number		
	Installed	In Service	Retired
1911	1	1	0
1925	2	0	2
1940	0	0	0
SUBTOTAL	3	1	2
Unknown	2	0	2
TOTAL	5	1	4

Retirements by Years

Year Installed	Number	Year	Number	Year
1925	1	1932	1	1934

8-IN. DISC METERS

Year Installed	Number		
	Installed	In Service	Retired
1911	1	1	0
1912	1	0	1
1913	1	1	0
1940	0	0	0
SUBTOTAL	3	2	1
Unknown	1	1	0
TOTAL	4	3	1

Retirements by Years

Year Installed	Number	Year
1912	1	1927

12-IN. DISC METERS

Year Installed	Number		
	Installed	In Service	Retired
1921	1	0	1
1940	0	0	0
SUBTOTAL	1	0	1
Unknown	1	0	1
TOTAL	2	0	2

Retirements by Years

Year Installed	Number	Year
1921	1	1936

3-IN. COMPOUND METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	1	1	0
1940	0	0	0
TOTAL	1	1	0

4-IN. COMPOUND METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1913	1	1	0
1920	2	2	0
1923	1	1	0
1924	1	1	0
1925	2	2	0
1926	1	1	0
1935	1	1	0
1940	0	0	0
TOTAL	9	9	0

6-IN. COMPOUND METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	3	3	0
1940	3	3	0
TOTAL	6	6	0

8-IN. COMPOUND METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1921	1	1	0
1927	2	2	0
1928	1	1	0
1940	0	0	0
TOTAL	4	4	0

2-IN. CURRENT METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	3	0	3
1891	1	0	1
1892	1	0	1
1893	2	0	2
1894	1	0	1
1897	1	0	1
1899	1	0	1
1903	4	3	1
1904	1	0	1

2-IN. CURRENT METERS (contd.)

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1905	5	4	1
1906	1	0	1
1907	1	0	1
1910	1	0	1
1920	1	1	0
1921	4	4	0
1922	1	1	0
1924	1	1	0
1925	1	1	0
1940	0	0	0
TOTAL	31	15	16

Retirements by Years

Year	Num-	Year	Num-	Year	Num-	Year
<i>Installed</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>	<i>ber</i>	<i>Year</i>
1889	1	1898	1	1900	1	1903
1891	1	1932				
1892	1	1915				
1893	1	1903	1	1904		
1894	1	1928				
1897	1	1905				
1899	1	1914				
1903	1	1926				
1904	1	1928				
1905	1	1928				
1906	1	1933				
1907	1	1921				
1910	1	1917				

3-IN. CURRENT METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1894	1	1	0
1895	2	2	0
1940	0	0	0
SUBTOTAL	3	3	0
Unknown	1	0	1
TOTAL	4	3	1

4-IN. CURRENT METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	1	0	1
1888	2	1	1
1889	1	1	0
1895	2	1	1
1898	1	1	0
1899	1	1	0

4-IN. CURRENT METERS (contd.)

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	1	1	0
1913	1	1	0
1916	1	1	0
1940	0	0	0
	<hr/>	<hr/>	<hr/>
TOTAL	11	8	3

Retirements by Years

<i>Year</i>		
<i>Installed</i>	<i>Number</i>	<i>Year</i>
1885	1	1911
1888	1	1913
1895	1	1923

6-IN. CURRENT METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1895	2	2	0
1900	1	0	1
1903	2	2	0
1910	1	1	0
1922	1	1	0
1940	0	0	0
	<hr/>	<hr/>	<hr/>
TOTAL	7	6	1

Retirements by Years

<i>Year</i>		
<i>Installed</i>	<i>Number</i>	<i>Year</i>
1900	1	1903

Rochester (Suburban), New York

As of December 31, 1940

THE Rochester plant of the Rochester & Lake Ontario Water Service Corporation, a private utility, renders water service in the towns of Greece, Gates, Brighton, Pittsford, Irondequoit, Penfield and Perinton; portions of the 10th, 18th, 21st, 23rd and 24th Wards of the city of Rochester; and the villages of East Rochester, Penfield and Pittsford. The company also sells water wholesale to other villages and water districts for resale to customers located therein. These communities are located in Monroe County suburban to the city of Rochester, N.Y.

The territory served by the Rochester plant is predominantly residential in character, although a few industries are located in the service area. As of Dec. 31, 1940, there were 15,570 customers, including three villages and nineteen water districts. There were in service approximately 229 mi. of mains with 683 valves and 1,210 fire hydrants. Sales in a service area having a population of 110,300 amounted to an average of 6.4 mgd., which is equivalent to 58 gpd. per capita.

Development of the Existing System

The Rochester & Lake Ontario Water Company was incorporated on Dec. 30, 1902. Plant construction was started in July 1903 and the first water service rendered in December 1904. Control of the Rochester & Lake On-

tario Water Company was acquired by the New York Water Service Corporation, in turn controlled by the Federal Water Service Company, in November 1927. In January 1928 the Rochester & Lake Ontario Water Company was consolidated with the Clyde Water Supply Company to form the Rochester & Lake Ontario Water Service Corporation. The plant serving the area around Rochester is known as the Rochester plant.

The supply of water comes from Lake Ontario and is obtained through an intake crib located about 4,300 ft. offshore, 21 ft. below normal lake level. The water flows from the intake crib through a 24-in. diameter cast-iron intake line into an intake well, located at the Charlotte pumping station.

The water is pumped by low-lift pumps from the intake well to two sedimentation basins, each having a capacity of 0.9 mil.gal. The settled water flows from these basins into two suction wells where it is picked up by high-lift pumps which pump through pressure filters to the distribution system. The water is treated before entering the intake well and at points in passing through the station with sulfate of alumina, lime, copper sulfate, ammonia, activated carbon and chlorine.

The primary station of the company is the Charlotte pumping station. It is located on the shore of Lake Ontario

TABLE 1
SUMMARY OF MAINS
ROCHESTER (SUBURBAN), NEW YORK

Size, in.	Kind	No of Feet In- stalled	Percent- age of Total	No of Feet Retired	Percent- age of Total	No. of Feet in Service	Percent- age of Total	Year of First In- stallation	Average Age, yr.
4	Cast-iron unlined	7,632	1.2	983	14.5	6,649	1.0	1905	31.8
6		179,997	27.6	2,321	34.3	177,676	27.6	1905	29.1
8		152,729	23.4	342	5.1	152,387	23.6	1905	28.7
10		4,800	0.7	0	0	4,800	0.7	1908	32.5
12		44,332	6.8	252	3.7	44,080	6.8	1905	34.0
20		139,920	21.4	2,345	34.6	137,575	21.3	1905	25.3
24	Cast-iron cement-lined	294	0.0	0	0	294	0	1926	14.5
6		72,973	11.2	6	0.1	72,967	11.3	1927	9.3
8		26,208	4.0	502	7.4	25,706	4.0	1927	9.8
12		8,778	1.4	0	0	8,778	1.4	1928	10.8
16		3,481	0.5	21	0.3	3,460	0.5	1931	6.7
20		6,442	1.0	0	0	6,442	1.0	1930	10.1
24	Steel	4,530	0.7	0	0	4,530	0.7	1930	10.5
20		528	0.1	0	0	528	0.1	1928	12.5
TOTAL		652,644	100.0	6,772	100.0	645,872	100.0		24.9
Percentage of Total		100 00		1.04		98.96			
Average Size, in.		10.4		11.1		10.4			

Mortality Survival Ratios

Size, in.	Kind	No. of Feet	Period Covered, yr	Percentage
4	Cast-iron unlined	7,632	35.5	86.947
6		179,997	35.5	97.918
8		152,729	35.5	99.578
10 and 12		49,132	35.5	99.470
Over 12		140,214	35.5	97.765
6	Cast-iron cement-lined	72,973	13.5	99.990
8		26,208	13.5	96.098
12		8,778	12.5	100.000
Over 12		14,453	10.5	99.852
20	Steel	528	12.5	100.000
TOTAL		652,644		

about 1,500 ft. west of the corporate limits of the city of Rochester in the town of Greece. It consists of one large building, erected in 1904, housing boilers, pumping and purification equipment, office and laboratory and, adjacent, two sedimentation basins and smaller auxiliary structures.

The main part of the station houses two water tube boilers equipped with stokers and auxiliaries; two steam-driven high-lift pumps, installed in 1905; one steam-driven low-lift pump, installed in 1907; two electric motor-driven low-lift pumps, one installed in 1923, and one in 1933; and three elec-

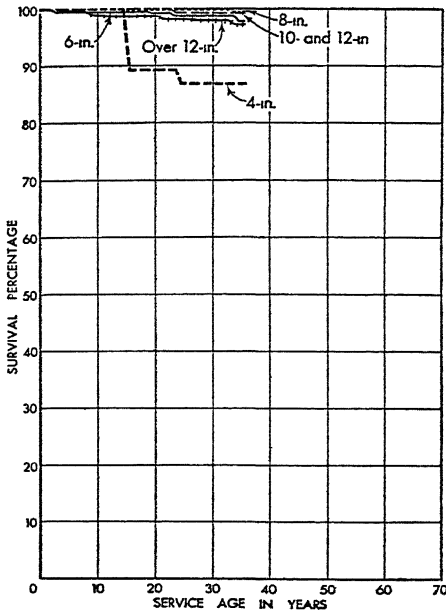


FIG. 1. Mortality Survival Curve—4-24-in. Cast-Iron Unlined Mains—Rochester (Suburban), New York

BASE: Feet		SURVIVAL: 1905-1940	
SIZE	EXPOSURES	RETIREMENTS	
in.	ft.	ft.	
4	7,632	983	
6	179,997	2,321	
8	152,729	342	
10 and 12	49,132	252	
Over 12	140,214	2,345	

tric motor-driven high-lift pumps, installed in 1912, 1916 and 1929. The elevation of the high-lift pumps is 260 ft. above sea level.

The filter room houses 22 high-pressure sand filters and auxiliary purification equipment. Eight filters were installed in 1905, two in 1917, four in 1925, six in 1930 and the final two in 1931. There are also two deep well pumps, installed in 1928 and 1930, located in the intake well.

Purified water is discharged at from 225- to 240-psi. pressure from the filter

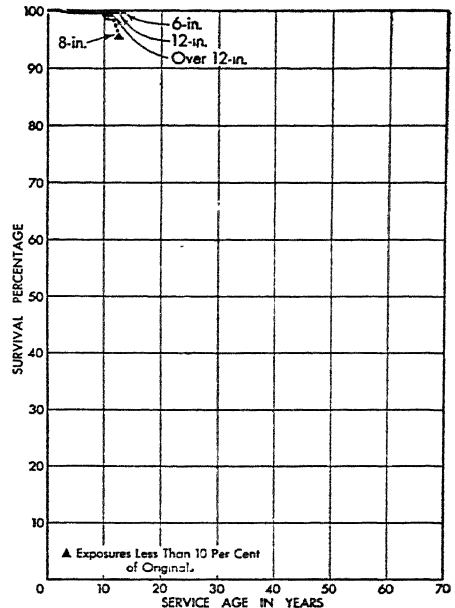


FIG. 2. Mortality Survival Curve—6-24-in. Cast-Iron Cement-Lined Mains—Rochester (Suburban), New York

BASE: Feet		SURVIVAL: 1927-1940	
SIZE	EXPOSURES	RETIREMENTS	
in.	ft.	ft.	
6	72,973	6	
8	26,208	502	
12	8,778	0	
Over 12	14,453	21	

effluent into two 20-in. cast-iron transmission mains. The original main, installed in 1904-1905, consists of 20-in. diameter pipe of Classes E to B. It carries water in a southeasterly direction to standpipes located on Cobb's Hill. The elevation of the overflow of these standpipes is 653 ft. From them water flows to the distribution system and through a third transmission main, 12 in. in diameter, installed in 1905, southeastwardly to the villages of East Rochester and Fairport.

The second transmission main, also 20 in. in diameter, installed in 1928, also carries water in the same general

TABLE 2
SUMMARY OF VALVES
ROCHESTER (SUBURBAN), NEW YORK

Size, in.	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, yr.
4	13	0	13	1905	25.8
6	513	2	511	1905	22.6
8	168	4	164	1905	25.0
10	5	0	5	1908	32.5
12	42	0	42	1905	19.0
16	4	0	4	1931	7.3
20	84	2	82	1905	22.2
24	1	0	1	1930	10.5
TOTAL	830	8	822		22.9
Percentage of Total	100.00	0.96	99.04		

Mortality Survival Ratios

Size, in.	Number Installed	Period Covered, yr.	Percentage
4	13	35.5	100.000
6	513	35.5	98.659
8	168	35.5	97.402
10 and 12	47	35.5	100.000
Over 12	89	35.5	95.987
TOTAL	830		

TABLE 3
SUMMARY OF HYDRANTS
ROCHESTER (SUBURBAN), NEW YORK

Size, in.	Kind	Number In- stalled	Number Re- tired	Number in Service	Year of First Instal- lation	Average Age, yr.	Mor- tality Survival Per- centage
4	Two 2½-in. nozzle	3	0	3	1931	9.5	85.648
4	Two 2½-in. and steamer nozzle	571	21	550	1905	21.3	
5	Two 2½-in. and steamer nozzle	212	24	188	1915	9.3	
TOTAL		786	45	741		18.2	
Percentage of Total		100.00	5.73	94.27			

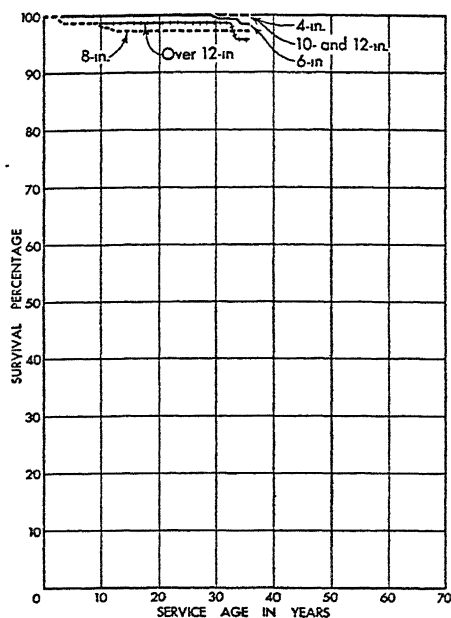


FIG. 3. Mortality Survival Curve—4-20-in. Valves—Rochester (Suburban), New York

BASE: Unit	SURVIVAL: 1905-1940	
SIZE	EXPOSURES	RETIREMENTS
<i>in.</i>	<i>Units</i>	<i>Units</i>
4	13	0
6	513	2
8	168	4
10 and 12	47	0
Over 12	89	2

direction to the standpipes on Cobb's Hill.

Distribution mains take off from the three transmission mains at various points along their lengths.

Pressures and adequate flows are maintained in the system by six booster stations, each consisting of a motor-driven pump and auxiliaries. These stations, and dates of construction, are as follows: Ridge Road (1917), Culver Road (1926), Pittsford (1928), Linden Road (1929), Echo Street (1931) and Cobb's Hill (1937).

The water storage facilities of the

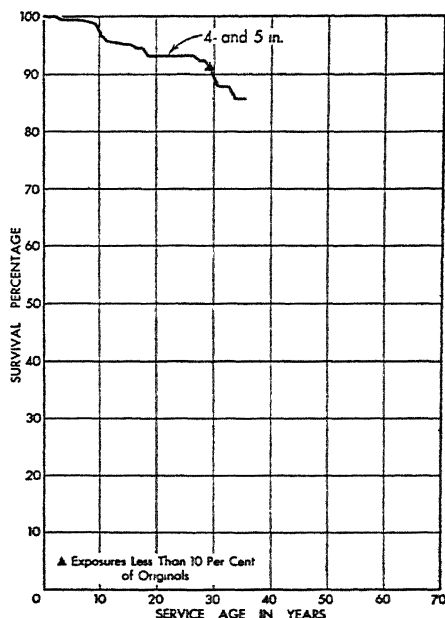


FIG. 4. Mortality Survival Curve—4- and 5-in. Hydrants—Rochester (Suburban), New York

BASE: Units	SURVIVAL: 1905-1940	
SIZE	EXPOSURES	RETIREMENTS
<i>in.</i>	<i>Units</i>	<i>Units</i>
4 and 5	786	45

plant include a steel standpipe of 2.651-mil.gal. capacity, elevation of overflow 653 ft., built on Cobb's Hill in 1904; one steel standpipe at the same elevation with 5.891-mil.gal. capacity, erected in 1930 at Cobb's Hill; and an elevated steel tank of 0.2-mil.gal. capacity, erected in 1930 and located at Buffalo Road and the Barge Canal in the southwestern part of the city of Rochester.

Basis of Study

The data on pipe, valves and hydrants relating to their installation and retirement are stated to be complete from the beginning of the plant.

TABLE 4
CAUSES OF RETIREMENT OF MAINS
ROCHESTER (SUBURBAN), NEW YORK

Size, in.	Kind	Length, ft.	Life, yr.	Cause of Retirement	Salvaged, ft
4	Cast-iron unlined	800	15.5	Replaced by 8-in. main	
		183	24.5	Salvaged and relocated	183
		983			183
6	Cast-iron unlined	544	2.5	Relocated	544
		460	19.5	Replaced by 8-in. main	—
		856	23.5	Replaced by 12-in. main	—
		11	30.5	Lowered	11
		450	34.5	Relocated	450
		2,321			1,005
8	Cast-iron unlined	22	3.5	Relocated	22
		120	24.5	Salvaged and lowered	120
		200	33.5	Relocated	200
		342			342
12	Cast-iron unlined	240	23.5	New bridge construction	—
		12	26.5	Lowered	12
		252			12
20	Cast-iron unlined	30	1.5	Relocated	30
		61	3.5	Lowered	61
		1,145	8.5	Relocated	1,145
		120	9.5		120
		464	21.5		464
		96	26.5	Lowered	96
		429	33.5	Relocated	429
		2,345			2,345
6	Cast-iron cement-lined	6	2.5	Relocated	6
		6			6
8	Cast-iron cement-lined	34	4.5	Relocated	34
		221	10.5		221
		29	11.5		29
		218	12.5		218
		502			502
16	Cast-iron cement-lined	21	3.5	Relocated	21
		21			21
	TOTAL	6,772			4,416

TABLE 5
CAUSES OF RETIREMENT OF VALVES
ROCHESTER (SUBURBAN), NEW YORK

Size, in.	Number	Life, yr.	Cause of Retirement	Number Salvaged
6	1	30.5	Pipe lowered	1
	1	34.5	Relocated	1
	2			2
8	2	3.5	Relocated	2
	1	10.5		1
	1	12.5		1
	4			4
20	1	3.5	Relocated	1
	1	33.5	Relocated	1
	2			2
TOTAL	8			8

Mortality Survival Study

Mortality studies were made of cast-iron mains, valves and hydrants. Table 1 gives a summary of the cast-iron pipe installed, retired and the amount remaining in service, as well as other pertinent data relating thereto. Figures 1 and 2 show the mortality survival curves covering the record of the pipe grouped as shown.

The summaries of valves and hydrants are given in Tables 2 and 3 and the applicable mortality survival curves in Figs. 3 and 4.

Causes of Retirement

The causes of retirement of cast-iron mains and valves are shown in Tables

4 and 5. No detailed causes of retirements of hydrants were available. The plant officials state as follows: "Majority of retirements were due to relocation or to damage by automobiles. In these cases hydrants were inspected, repaired and installed in a new location or reset at another location at some later date."

Acknowledgment

The collection and compilation of data pertaining to the Rochester plant were under the general supervision of E. L. Heyser, Chief Valuation Engineer of the New York Water Service Corporation.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
ROCHESTER (SUBURBAN), NEW YORK

MAINS

4-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1905	2,310	2,310	0
1907	843	660	183
1910	3,608	2,808	800
1914	744	744	0
1917	32	32	0
1927	90	90	0
1929	5	5	0
1940	0	0	0
TOTAL	7,632	6,649	983

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>		
1907	183	1931
1910	800	1925

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1905	36,058	34,741	1,317
1906	11,247	11,247	0
1907	21,161	21,161	0
1908	5,777	5,777	0
1909	4,739	4,739	0
1910	3,315	3,315	0
1911	7,258	6,798	460
1912	4,634	4,634	0
1913	37,739	37,739	0
1914	8,628	8,628	0
1915	12,858	12,858	0
1916	5,364	5,364	0
1917	2,374	2,374	0
1919	120	120	0
1921	3,858	3,858	0
1922	2	2	0
1923	12	12	0
1924	5,732	5,732	0
1925	516	516	0
1926	3,096	3,096	0
1927	2,123	1,579	544
1928	3,383	3,383	0
1929	3	3	0
1940	0	0	0
TOTAL	179,997	177,676	2,321

6-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
<i>Installed</i>			
1905	856	1928	11
1911	460	1930	450
1927	544	1929	1939

8-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1905	37,574	37,374	200
1906	2,124	2,124	0
1907	23,658	23,538	120
1909	4,319	4,319	0
1911	971	971	0
1913	52,860	52,860	0
1914	1,080	1,080	0
1915	4,250	4,250	0
1916	3,504	3,504	0
1919	1,800	1,800	0
1920	1,924	1,924	0
1921	2	2	0
1924	1,207	1,207	0
1925	2,229	2,229	0
1926	5,580	5,580	0
1927	9,172	9,172	0
1928	407	407	0
1929	15	15	0
1930	16	16	0
1934	27	5	22
1937	10	10	0
1940	0	0	0
TOTAL	152,729	152,387	342

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>		
1905	200	1938
1907	120	1931
1934	22	1937

10-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1908	4,800	4,800	0
1940	0	0	0
TOTAL	4,800	4,800	0

12-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1905	36,628	36,376	252
1909	3,677	3,677	0
1910	2,384	2,384	0
1924	38	38	0
1926	64	64	0
1927	144	144	0
1929	1,357	1,357	0
1930	40	40	0
1940	0	0	0
TOTAL	44,332	44,080	252

Retirements by Years

Year	Feet		Year	Feet		Year
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1905	240	1928	12	1931		

20-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1905	77,228	74,883	2,345
1906	168	168	0
1908	108	108	0
1913	1,352	1,352	0
1914	259	259	0
1917	419	419	0
1925	107	107	0
1926	574	574	0
1928	59,455	59,455	0
1930	120	120	0
1938	130	130	0
1940	0	0	0
TOTAL	139,920	137,575	2,345

Retirements by Years

Year	Feet		Year	Feet		Year
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1905	30	1906	61	1908	1,145	1913
	120	1914	464	1926	96	1931
	429	1938				

24-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	294	294	0
1940	0	0	0
TOTAL	294	294	0

6-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	14,865	14,865	0
1928	9,137	9,137	0
1929	15,897	15,897	0
1930	6,089	6,089	0
1931	5,984	5,984	0
1932	42	42	0
1933	3,164	3,164	0
1934	774	774	0
1935	280	280	0
1936	465	465	0
1937	3,056	3,050	6
1938	1,750	1,750	0
1939	5,908	5,908	0
1940	5,562	5,562	0
TOTAL	72,973	72,967	6

Retirements by Years

Year	Feet		Year
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1937	6	1939	

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	2,003	1,974	29
1928	7,123	6,684	439
1929	5,902	5,902	0
1930	4,216	4,216	0
1931	33	33	0
1934	61	27	34
1936	4,430	4,430	0
1937	2,206	2,206	0
1938	234	234	0
1940	0	0	0
TOTAL	26,208	25,706	502

Retirements by Years

Year	Feet		Year	Feet		Year
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1927	29	1938				
1928	221	1938	218	1940		
1934	34	1938				

12-IN. CAST-IRON CEMENT-LINED MAINS			
Year	Feet		
Installed	Installed	In Service	Retired
1928	2,455	2,455	0
1929	3,271	3,271	0
1930	354	354	0
1931	152	152	0
1932	2,482	2,482	0
1933	3	3	0
1937	61	61	0
1940	0	0	0
TOTAL	8,778	8,778	0

16-IN. CAST-IRON CEMENT-LINED MAINS			
Year	Feet		
Installed	Installed	In Service	Retired
1931	233	233	0
1934	3,236	3,215	21
1937	12	12	0
1940	0	0	0
TOTAL	3,481	3,460	21

Retirements by Years		
Year	Feet	Year
Installed		
1934	21	1937

20-IN. CAST-IRON CEMENT-LINED MAINS			
Year	Feet		
Installed	Installed	In Service	Retired
1930	5,868	5,868	0
1931	251	251	0
1934	10	10	0
1938	313	313	0
1940	0	0	0
TOTAL	6,442	6,442	0

24-IN. CAST-IRON CEMENT-LINED MAINS			
Year	Feet		
Installed	Installed	In Service	Retired
1930	4,530	4,530	0
1940	0	0	0
TOTAL	4,530	4,530	0

20-IN. STEEL MAINS			
Year	Feet		
Installed	Installed	In Service	Retired
1928	528	528	0
1940	0	0	0
TOTAL	528	528	0

VALVES

4-IN. VALVES			
Year	Number		
Installed	Installed	In Service	Retired
1905	3	3	0
1908	1	1	0
1910	3	3	0
1914	2	2	0
1917	3	3	0
1929	1	1	0
1940	0	0	0
TOTAL	13	13	0

6-IN. VALVES			
Year	Number		
Installed	Installed	In Service	Retired
1905	121	119	2
1906	8	8	0
1907	26	26	0
1908	8	8	0
1909	9	9	0
1910	5	5	0
1911	11	11	0
1912	10	10	0

6-IN. VALVES (contd.)			
Year	Number		
Installed	Installed	In Service	Retired
1913	37	37	0
1914	15	15	0
1915	18	18	0
1916	8	8	0
1917	14	14	0
1919	2	2	0
1921	7	7	0
1922	4	4	0
1923	3	3	0
1925	2	2	0
1926	7	7	0
1927	40	40	0
1928	41	41	0
1929	32	32	0
1930	8	8	0
1931	48	48	0
1932	1	1	0
1933	3	3	0
1934	1	1	0
1935	1	1	0
1936	1	1	0
1937	7	7	0

6-IN. VALVES (contd.)

Year	Feet		
Installed	Installed	In Service	Retired
1938	5	5	0
1939	6	6	0
1940	4	4	0
TOTAL	513	511	2

Retirements by Years

Year	Number		Year	Number	
Installed	Number	Year	Number	Year	Number
1905	1	1935	1	1939	

8-IN. VALVES

Year	Number		
Installed	Installed	In Service	Retired
1905	55	55	0
1906	1	1	0
1907	10	10	0
1909	3	3	0
1911	2	2	0
1913	29	29	0
1914	2	2	0
1915	2	2	0
1916	5	5	0
1919	1	1	0
1920	2	2	0
1924	3	3	0
1925	2	2	0
1926	5	5	0
1927	3	3	0
1928	13	11	2
1929	3	3	0
1930	5	5	0
1931	5	5	0
1934	7	5	2
1936	6	6	0
1937	2	2	0
1938	2	2	0
1940	0	0	0
TOTAL	168	164	4

Retirements by Years

Year	Number		Year	Number	
Installed	Number	Year	Number	Year	Number
1928	1	1938	1	1940	
1934	2	1937			

10-IN. VALVES

Year	Number		
Installed	Installed	In Service	Retired
1908	5	5	0
1940	0	0	0
TOTAL	5	5	0

12-IN. VALVES

Year	Number		
Installed	Installed	In Service	Retired
1905	9	9	0
1909	2	2	0
1910	4	4	0
1926	3	3	0
1927	2	2	0
1928	3	3	0
1929	8	8	0
1930	5	5	0
1932	3	3	0
1933	1	1	0
1937	2	2	0
1940	0	0	0
TOTAL	42	42	0

16-IN. VALVES

Year	Number		
Installed	Installed	In Service	Retired
1931	1	1	0
1934	3	3	0
1940	0	0	0
TOTAL	4	4	0

20-IN. VALVES

Year	Number		
Installed	Installed	In Service	Retired
1905	36	34	2
1908	3	3	0
1917	2	2	0
1925	1	1	0
1926	3	3	0
1928	26	26	0
1930	4	4	0
1931	3	3	0
1934	1	1	0
1938	4	4	0
1940	1	1	0
TOTAL	84	82	2

Retirements by Years

Year	Number		Year	Number	
Installed	Number	Year	Number	Year	Number
1905	1	1908	1	1938	

24-IN. VALVES

Year	Number		
Installed	Installed	In Service	Retired
1930	1	1	0
1940	0	0	0
TOTAL	1	1	0

HYDRANTS

4-IN. HYDRANTS—4-IN. VALVE, 6-IN.
CONNECTION, TWO HOSE NOZZLES

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	3	3	0
1940	0	0	0
TOTAL	3	3	0

4-IN. HYDRANTS—4-IN. VALVE, 6-IN.
CONNECTION, TWO HOSE AND
ONE STEAMER NOZZLE

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1905	22	20	2
1906	7	7	0
1907	12	11	1
1908	8	7	1
1909	4	4	0
1910	7	7	0
1911	8	8	0
1912	34	33	1
1913	2	2	0
1914	27	27	0
1915	73	73	0
1916	40	40	0
1917	7	7	0
1919	29	23	6
1920	25	24	1
1921	36	36	0
1922	6	6	0
1923	11	11	0
1924	104	100	4
1925	33	31	2
1926	17	17	0
1927	24	23	1
1928	7	6	1
1929	1	1	0
1930	2	2	0
1931	1	1	0
1933	1	1	0
1934	2	2	0
1935	1	1	0
1936	2	2	0
1937	4	3	1
1938	3	3	0
1939	7	7	0
1940	4	4	0
SUBTOTAL	571	550	21
UNKNOWN	9	0	9
TOTAL	580	550	30

4-IN. HYDRANTS—4-IN. VALVE, 6-IN.
CONNECTION, TWO HOSE AND ONE
STEAMER NOZZLE (contd.)

Retirements by Years

Year	Number		Year	Number	
<i>Installed</i>	<i>Number</i>		<i>Year</i>	<i>Number</i>	<i>Year</i>
1905	2		1935		
1907	1		1940		
1908	1		1937		
1912	1		1939		
1919	1		1931	5	1937
1920	1		1931		
1924	1		1938	3	1940
1925	1		1936	1	1938
1927	1		1938		
1928	1		1939		
1937	1		1940		

5-IN. HYDRANTS—5-IN. VALVE, 6-IN.
CONNECTION, TWO HOSE AND
ONE STEAMER NOZZLE

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1915	1	1	0
1927	5	5	0
1928	53	45	8
1929	32	22	10
1930	35	33	2
1931	45	41	4
1933	4	4	0
1935	1	1	0
1936	3	3	0
1937	2	2	0
1938	13	13	0
1939	4	4	0
1940	14	14	0
TOTAL	212	188	24

Retirements by Years

Year	Num-ber	Year	Num-ber	Year	Num-ber	Year
<i>Installed</i>		<i>Year</i>		<i>Year</i>		<i>Year</i>
1928	1	1931	6	1938	1	1939
1929	10	1939				
1930	2	1939				
1931	1	1936	2	1938	1	1939

Sag Harbor, New York

As of December 31, 1940

THE villages of Sag Harbor and North Hampton, N.Y., and surrounding area lying within the towns of Southampton and East Hampton, Suffolk County, located on the eastern end of Long Island, receive water service from the Sag Harbor plant of the New York Water Service Corporation, a private corporation.

These villages are small, largely residential in character and are located in the summer resort area of eastern Long Island.

For the year ending 1940 the company furnished water to 559 customers in a territory having a population of approximately 2,600. Sales of water averaged 0.083 mgd., which is equivalent to 32 gpd. per capita.

Development of the Existing System

The Sag Harbor Water Company was incorporated on Dec. 19, 1888. Plant construction was started in March of 1889 and water service commenced in the latter part of the year. In 1893 the Fahys Watch Case Company acquired control of the water company and operated the plant until August 1928 when Francis W. Collins took over the management.

In June 1930 the Federal Water Service Corporation acquired control of the Sag Harbor Water Company. In November it was merged with and became the Sag Harbor plant of the New York Water Service Corporation, a subsidiary of Federal Water & Gas Corporation.

The original source of water supply was secured from four dug wells located in the southern part of the village of Sag Harbor. Because of the high iron content of the water from these wells, in 1897, the company secured permission to take water from Long Pond, located in the town of Southampton just south of Sag Harbor. The water flows from Long Pond northwesterly down Ligonee Brook about 1,700 ft. and thence through 590 ft. of 12-in. diameter terra cotta pipe to a brick basin constructed in one of the wells. Water was allowed to coagulate in this basin and then was pumped into the system by steam driven pumps.

In 1920 the company purchased land on three sides of Long Pond and erected a small concrete dam 4 ft. high and about 19 ft. long at the northwest corner. The top of the dam is only 10.7 ft. above sea level. In 1922 the flow from Long Pond was increased by deepening Ligonee Brook and a concrete intake and screen chamber were constructed at the lower end and connected to the 12-in. terra cotta pipeline.

In 1924 an electric pumping station was erected and the operation of the steam station was discontinued.

Two wells were installed to augment the supply, one in 1926 and the other in 1931. The first well was 6 in. in diameter and 55 ft. deep. The second well is a 10-in. well 129 ft. deep. The 6-in. well was not in use in 1940 but was in reserve and had a potential yield

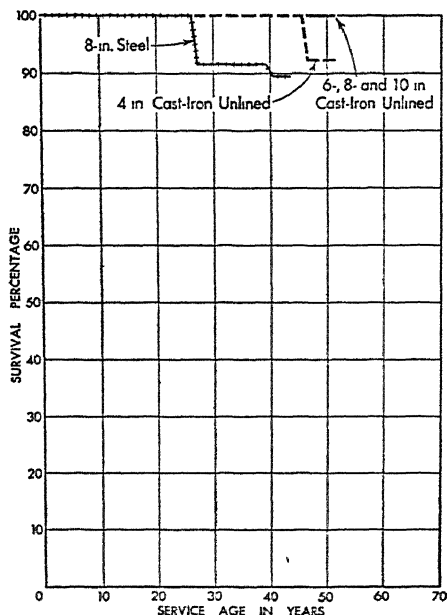


FIG. 1. Mortality Survival Curve—4-10-in. Cast-Iron Unlined and 8-in. Steel Mains—Sag Harbor, New York

BASE: Feet		SURVIVAL: 1889-1940	
SIZE	KIND	EXPOSURES	RETIREMENTS
in.		ft.	ft.
4	Cast-Iron Unlined	26,231	1,100
6		9,919	0
8		2,050	0
10	Steel	2,871	0
8		1,025	104

of 0.4 mgd. The 10-in. well was in use and yielded, on an average, 0.576 mgd.

In 1937 the boilers and all steam equipment were removed from the original steam station and two steel pressure filters were installed. Water now is pumped from the wells to an aerator through which it flows by gravity to a coagulating basin and thence through a sedimentation basin. It is then pumped through the pressure filters to the distribution system.

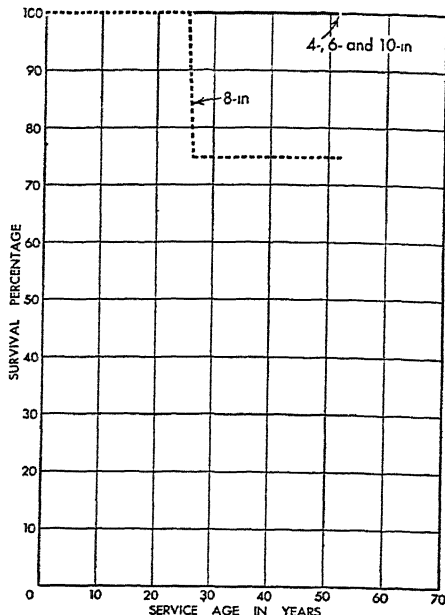


FIG. 2. Mortality Survival Curve—4-10-in. Valves—Sag Harbor, New York

BASE: Unit		SURVIVAL: 1889-1940	
SIZE	EXPOSURES	RETIREMENTS	
in.	Units	Units	
4	46	0	
6	10	0	
8	9	2	
10	2	0	

The pumping equipment consists of two 300-gpm., duplex high-lift pumps, driven by 15-hp. motors installed in 1924 and a low-lift, 300-gpm. centrifugal well pump, installed in 1937.

Water storage facilities consist of an open steel standpipe, 20 ft. in diameter by 100 ft. high, capacity 235,000 gal., erected in 1889 in Sag Harbor, with overflow at an elevation of 136 ft.

As of Dec. 31, 1940, the company had in service approximately 8 mi. of pipe from 1 to 10 in. in diameter, with 66 valves and 70 fire hydrants. Metered customers numbered 257 and flat-rate customers 302.

TABLE 1
SUMMARY OF MAINS
SAG HARBOR, NEW YORK

Size, <i>in.</i>	Kind	No of Feet Installed	Percentage of Total	No of Feet Retired	Percentage of Total	No. of Feet in Service	Percentage of Total	Year of First Installation	Average Age, <i>yr.</i>
4	Cast-iron unlined	26,231	58.3	1,100*	91.40	25,131	57.40	1889	40.4
6		9,919	22.1	0	0	9,919	22.70	1889	47.1
8		2,250	5.0	0	0	2,250	5.10	1889	46.1
10	Cast-iron cement-lined	2,871	6.4	0	0	2,871	6.60	1889	51.5
6		2,672	5.9	0	0	2,672	6.10	1936	1.2
8	Steel	1,025	2.3	104†	8.60	921	2.10	1897	43.1
TOTAL		44,968	100.0	1,204	100.00	43,764	100.00		40.6
Percentage of Total		100.00		2.68		97.32			
Average Size, <i>in.</i>		5.2		5.3		5.2			

Mortality Survival Ratios

Size, <i>ins</i>	Kind	No. of Feet	Period Covered, <i>yr.</i>	Percentage
4	Cast-iron unlined	26,231	51.5	92.239
6-10		15,040	51.5	100.000
6	Cast-iron cement-lined Steel	2,672	4.5	100.000
8		1,025	43.5	89.733
TOTAL		44,968		

* Dredging of channel in bay required installation at different location. Abandoned.

† Abandoned because of new pump station and filter installation.

TABLE 2
SUMMARY OF VALVES
SAG HARBOR, NEW YORK

Size, <i>in.</i>	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, <i>yr.</i>
4	46	0	46	1889	41.3
6	10	0	10	1889	41.8
8	9	2*	7	1889	46.5
10	2	0	2	1889	51.5
TOTAL		67	65		42.2
Percentage of Total		100.00	2.99	97.01	

TABLE 2 (contd.)
Mortality Survival Ratios

Size, in.	Number Installed	Period Covered, yr.	Percentage
4	46	51.5	100.000
6	10	51.5	100.000
8	9	51.5	75.000
10	2	51.5	100.000
TOTAL	67		

* Abandoned because of new pump station and filter installation.

Basis of Study

The records of the system with reference to pipe and valves are complete from the original date of installation.

Mortality Survival Study

Mortality studies of mains and valves were made. Table 1 is a summary of mains installed, retired and remaining in service, as well as other pertinent data relating thereto. Figure 1 shows the mortality survival curves covering the above record.

Table 2 and Fig. 2 are similar sum-

mary and mortality survival curves covering valves installed and retired.

Causes of Retirement

The causes of retirement of mains and valves are shown in footnotes in Tables 1 and 2, respectively.

Acknowledgment

The collection and compilation of data for the study in the Sag Harbor plant were under the general supervision of E. L. Heyser, Chief Valuation Engineer of the New York Water Service Corporation.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
SAG HARBOR, NEW YORK

MAINS

4-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	12,170	12,170	0
1891	2,003	903	1,100
1900	581	581	0
1902	2,548	2,548	0
1904	462	462	0
1906	1,460	1,460	0
1907	2,406	2,406	0
1916	620	620	0
1920	213	213	0
1921	252	252	0
1926	1,764	1,764	0
1927	1,752	1,752	0
1940	0	0	0
TOTAL	26,231	25,131	1,100

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>		
1891	1,100	1937

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	8,260	8,260	0
1891	792	792	0
1937	867	867	0
1940	0	0	0
TOTAL	9,919	9,919	0

8-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	2,005	2,005	0
1924	25	25	0

8-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1937	20	20	0
1940	0	0	0
TOTAL	2,250	2,250	0

10-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	2,871	2,871	0
1940	0	0	0
TOTAL	2,871	2,871	0

6-IN. CAST-IRON CEMENT-LINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1936	105	105	0
1937	244	244	0
1938	149	149	0
1939	366	366	0
1940	1,808	1,808	0
TOTAL	2,672	2,672	0

8-IN. STEEL MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1897	1,013	909	104
1924	12	12	0
1940	0	0	0
TOTAL	1,025	921	104

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>				
1897	86	1924	18	1937

VALVES

4-IN. VALVES			
<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	26	26	0
1900	2	2	0
1902	2	2	0
1904	2	2	0
1906	3	3	0
1907	4	4	0
1916	1	1	0
1921	1	1	0
1926	3	3	0
1939	1	1	0
1940	1	1	0
TOTAL	46	46	0

6-IN. VALVES			
<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	7	7	0
1891	1	1	0
1936	1	1	0
1937	1	1	0
1940	0	0	0
TOTAL	10	10	0

8-IN. VALVES			
<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	6	6	0
1897	2	0	2
1924	1	1	0
1940	0	0	0
TOTAL	9	7	2

<i>Retirements by Years</i>		
<i>Year</i>	<i>Number</i>	<i>Year</i>
1897	2	1924

10-IN. VALVES			
<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	2	2	0
1940	0	0	0
TOTAL	2	2	0

St. Marys, Pennsylvania

As of December 31, 1941

THE St. Marys Water Co. is a privately-owned water company serving the Borough of St. Marys and surrounding territory in Elk County in the northwestern section of Pennsylvania. The 1940 population of the borough was 7,653.

St. Marys is primarily an industrial community. It is east of the main producing oil fields but natural gas occurs in the vicinity and is piped throughout the borough. It is slightly north of the bituminous coal fields but there are important mines some 5 mi. south. The important industries in St. Marys are the manufacture of clay products, such as brick, fire brick, tile and sewer pipe; tanneries; a foundry; an incandescent lamp factory; and two concerns manufacturing carbon products.

It is located on the top of the divide between the Allegheny and Susquehanna watersheds and it is necessary to pump the entire supply uphill to the borough.

As of the date of this study there were 1,976 consumers serving approximately 8,200 people within and without the borough limits. Water delivered to the system during 1941 averaged 0.8 mgd. or about 98 gpd. per capita. Of this amount about 49 per cent was served to the industries.

Development of the Existing System

The St. Marys Water Co. was incorporated in 1889 and has been owned and operated as a private system under

several owners. The company was acquired by the Community Water Service Co. in 1928, the controlling interest in which passed to the American Water Works & Electric Co., Inc., in 1936.

The company secures its supply from four sources located in different directions from the borough. Three of these sources are surface supplies, augmented at times from wells at each location, and the fourth source is a well supply less frequently operated.

Silver Creek Supply

The first source of supply, developed in 1889, was the Silver Creek supply, obtained at a small intake dam of timber construction on Silver Creek about 2 mi. northwest of St. Marys. This creek has a gentle rolling watershed area of 1.54 sq.mi. at the intake. The original source was pumped by a steam plant which was abandoned in 1926. The surface supply is augmented from wells, the first well being drilled in 1895. Seven additional wells have been added over the years.

Laurel Run Supply

The second supply, Laurel Run, was developed in 1898 and is obtained about 3 mi. south of St. Marys from a watershed area of 1.7 sq.mi. A small reservoir, impounding from 2 to 3 mil.gal., is formed by a small concrete dam. Seven wells have also been drilled to augment the surface supply.

TABLE 1
SUMMARY OF MAINS
ST. MARYS, PENNSYLVANIA

Size, <i>in.</i>	Kind	No. of Feet Installed	Percent- age of Total	No. of Feet Retired	Percent- age of Total	No. of Feet in Service	Percent- age of Total	Year of First Instal- lation	Average Age, <i>yr.</i>
1	Wrought-iron	305	0.2	0	0	305	0.2	1900	41.5
1½		1,395	0.8	750	7.2	645	0.4	1900	35.5
1½		261	0.1	0	0	261	0.1	1900	41.5
2		6,242	3.4	3,994	38.2	2,248	1.3	1898	38.1
4		6,309	3.4	4,619	44.2	1,690	1.0	1889	43.5
5	Cast-iron unlined	876	0.5	0	0	876	0.5	1900	41.5
6		22,969	12.4	511	4.9	22,458	12.8	1897	42.6
4		64,543	34.8	571	5.5	63,972	36.6	1891	36.0
6		26,781	14.4	0	0	26,781	15.3	1891	35.9
8		23,481	12.7	0	0	23,481	13.4	1907	34.5
2	Cast-iron cement-lined	9,800	5.3	0	0	9,800	5.6	1931	2.6
4		1,422	0.7	0	0	1,422	0.8	1931	6.1
6		10,774	5.8	0	0	10,774	6.2	1928	8.1
8		10,107	5.5	0	0	10,107	5.8	1927	14.5
TOTAL		185,265	100.0	10,445	100.0	174,820	100.0		31.7
Percentage of Total		100.0		5.6		94.4			
Average Size, <i>in.</i>		5.18		3.14		5.30			

Mortality Survival Ratios

Size, <i>in.</i>	Kind	No. of Feet	Period Covered, <i>yr.</i>	Percentage
1-1½	Wrought-iron	1,961	41.5	61.754
2-6		36,396	44.5	74.174
4		64,543	50.5	98.028
6		Cast-iron unlined	26,781	50.5
8	23,481		34.5	100.000
2	9,800		10.5	100.000
4	Cast-iron cement-lined		1,422	10.5
6		10,774	13.5	100.000
8		10,107	14.5	100.000
	TOTAL	185,265		

Wolf Lick Run Supply

The Wolf Lick Run supply is obtained from a rugged, mountainous watershed of 3.28 sq.mi. in an area located about 5 mi. southeast of St. Marys. The reservoir, with a capacity of 8.5 mil.gal., is formed by a com-

bination concrete and earthen dam with concrete spillway and wasteway.

This source, presently the largest and most important and the third in time of development, was put into service in 1908. As with the other sources, wells are also located here and are used at times.

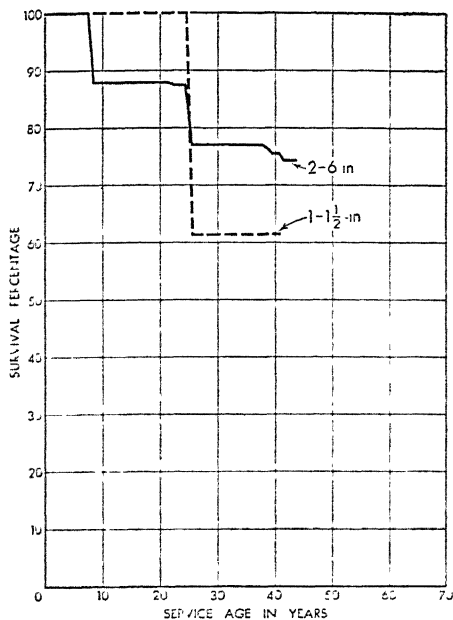


FIG. 1. Mortality Survival Curve—1-6-in. Wrought-Iron Mains—St. Marys, Pa., Water Co.

BASE: Feet	SURVIVAL: 1899-1940	
SIZE	EXPOSURES	RETIREMENTS
in.	ft.	ft.
1-1½	1,961	750
2-6	36,396	9,124

Luhrling Pines Supply

This supply is secured from wells located about 2 mi. north of the eastern end of the borough. It was developed in 1926 and 1927 and is generally used only when the surface and well supplies at the other three sources are inadequate. Six wells, pumped by air lift, discharge into an open, circular, reinforced concrete collecting basin with a capacity of 100,000 gal. The basin also serves as a suction well for the pumps.

The wells located at the several sources are generally 6 and 8 in. in

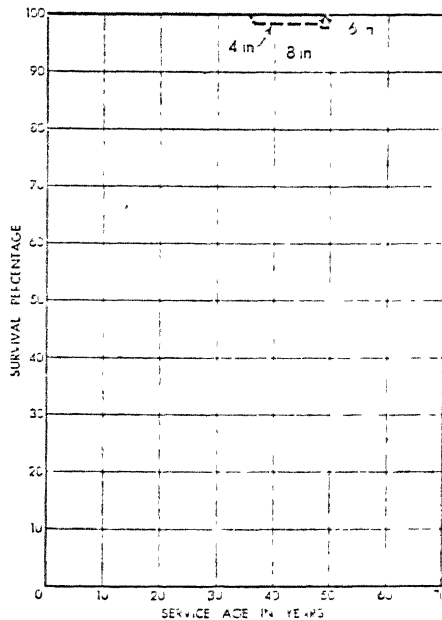


FIG. 2. Mortality Survival Curve—4-8-in. Cast-Iron Unlined Mains—St. Marys, Pa. Water Co.

BASE: Feet	SURVIVAL: 1891-1940	
SIZE	EXPOSURES	RETIREMENTS
in.	ft.	ft.
4	64,543	571
6	26,781	0
8	23,481	0

diameter, from 100 to 300 ft. deep, cased for from 20 to 30 ft. in depth and all pumped by air lift.

No treatment other than chlorination is given at any of the supply points. Small pumping stations housing natural gas, engine-driven triplex pumps for high-lift and air compressors for air-lift pumping of wells are located at each supply point. They pump the supply to distribution reservoirs or to the system.

From the Silver Creek supply a 6-in. black wrought-iron pipeline, 4,390 ft. long, laid in 1889, extends to the North Michael Reservoir.

TABLE 2
SUMMARY OF METERS
ST. MARYS, PENNSYLVANIA

Size, in.	Kind	Number Installed	Number Identified	Number Retired	Number in Service	Average Age, yr.
$\frac{5}{8}$	Disc	1,989	1,841	258	1,583	12.2
$\frac{3}{4}$		112	83	18	65	14.0
1		28	28	8	20	8.6
$1\frac{1}{4}$		7	7	1	6	27.8
$1\frac{1}{2}$		14	7	3	4	4.5
2	Current	15	9	5	4	6.5
3		14	13	3	10	10.8
4		2	2	1	1	9.5
6		1	1	0	1	23.5
TOTAL		2,182	1,991	297	1,694	12.3
Percentage of Total			100.0	14.9	85.1	

Mortality Survival Ratios

Size, in.	Kind	Number Identified	Period Covered, yr.	Percentage
$\frac{5}{8}$	Disc	1,841	18.5	75.949
$\frac{3}{4}$ -6	All	150	32.5	23 295
TOTAL		1,991		

TABLE 3
SUMMARY OF HYDRANTS
ST. MARYS, PENNSYLVANIA

Size, in.	Number Installed	Number Retired	Number in Service	Average Age, yr.	Mortality Survival Ratio, %
4	91	18	73	27.6	61.579
Percentage of Total		100.0	19.8	80.2	

From the Laurel Run supply a 6-in. black wrought-iron pipeline, 15,200 ft. long, laid in 1898, extends to the South Michael Reservoir.

The Wolf Lick supply is pumped to the South Michael Reservoir through an 8-in. cast-iron main, 23,390 ft. long, laid in 1907.

The Luhning Pines supply is pumped directly to the distribution system through an 8-in. cast-iron line, 10,165 ft. long, laid in 1926.

The North Michael Reservoir, constructed in 1919, is a covered, circular, reinforced-concrete basin, 67 ft. in diameter by 21 ft. deep, holding 500,000

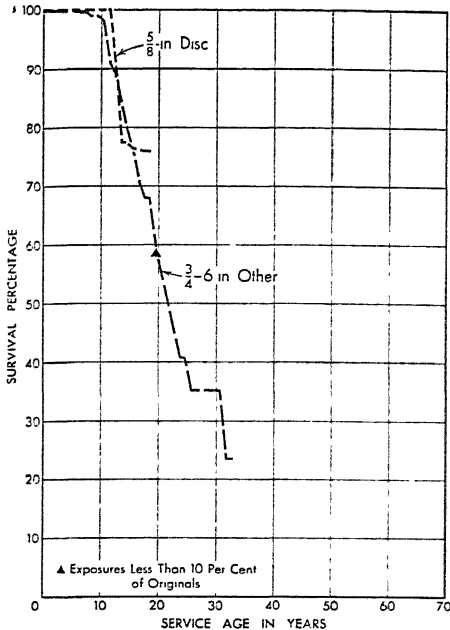


FIG. 3. Mortality Survival Curve— $\frac{5}{8}$ -6-in. Meters—St. Marys, Pa., Water Co.

BASE: Unit SURVIVAL: 1905-1937

SIZE in.	KIND	EXPOSURES	RETIREMENTS
$\frac{5}{8}$	Disc	1,841	258
$\frac{3}{4}$ -6	Other	150	39

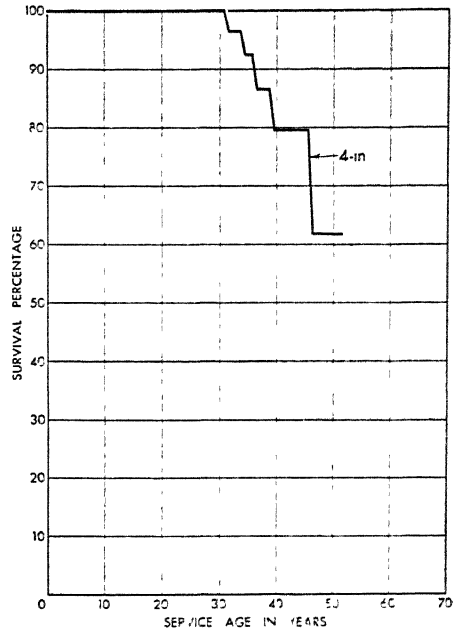


FIG. 4. Mortality Survival Curve—4-in. Hydrants—St. Marys, Pa., Water Co.

BASE: UNIT SURVIVAL: 1889-1940

SIZE in.	EXPOSURES	RETIREMENTS
4	91	18

gal. and divided into two parts having separate connections.

The South Michael Reservoir, constructed in 1911, is a square, open, earth embankment reservoir, concrete lined, having a capacity of 2 mil.gal.

The pipe system totals about 33 mi. to which are attached 1,976 services, originally largely galvanized wrought iron, but from 1928 to 1936 cement-lined wrought iron and from 1936 to date copper tubing. Almost all services are metered and account for approximately 78.5 per cent of the water served to the system.

Basis of Study

The records of installation and retirement of pipe and hydrants are substantially complete from the formation of the company to date. The record of installation and retirement of meters through 1937 only is presented herewith.

Mortality Survival Study

Mortality studies were made of mains, meters and hydrants. Table 1 is a summary of the pipe installed, the amount retired and that still in service,

as well as average ages, length of record and other pertinent data. Figures 1 and 2 show the mortality survival curves covering the amount and sizes of pipe grouped as shown.

Tables 2 and 3 and accompanying Figs. 3 and 4 represent similar data and curves covering meters and hydrants, respectively.

A brief summary of Class B facilities covering impounding and distribution reservoirs, wells and pumping equipment is given below.

Causes of Retirement

There exists no complete record from which could be determined the causes of retirement of mains, meters and hydrants.

Acknowledgments

The collection and compilation of data pertaining to the St. Marys Water Co. were carried out by the personnel of the American Water Works & Electric Co., Inc.

SUMMARY OF CLASS B FACILITIES

ST. MARYS, PENNSYLVANIA

Impounding Reservoirs

Silver Creek Reservoir—Timber crib dam, maximum height 5 ft., length 24 ft.; impounding 0.15 mil.gal. Constructed in 1889; still in service.

Wolf Lick Reservoir—Concrete, stone and earth dam, maximum height 30.3 ft., length 200 ft.; impounding 8.5 mil.gal. Constructed in 1906–1907; still in service. Timber spillway replaced by concrete in 1916.

Laurel Run Reservoir—Concrete dam, maximum height 8 ft., length 185 ft.; impounding 2.4 mil.gal. Constructed in 1904; still in service. Original dam of timber constructed in 1898 replaced with concrete dam in 1904.

Distribution Reservoirs

South Michael Reservoir—Original timber construction reservoir, covered, partly in cut; 30 ft. wide by 80 ft. long by 8 ft. deep; capacity 0.10 mil.gal. Constructed in 1898; replaced by new reservoir in 1912. Two similar reservoirs were constructed in 1902 and also retired in 1912 by the construction of the new reservoir. The existing South Michael Reservoir was constructed in 1912 and is still in service. It is of earth embankment, uncovered, with concrete lining, 117 ft. square at bottom, 162 ft. square at top, 14 ft. deep; capacity 2.0 mil.gal.

North Michael Reservoir—Covered, reinforced concrete reservoir, 67 ft. in diameter,

21 ft. deep; capacity 0.50 mil.gal. Constructed in 1919; still in service.

Luhring Pines Basin—Open, reinforced concrete with earth backing, receiving and suction basin; 50 ft. in diameter by 7 ft. deep; capacity 0.10 mil.gal. Constructed in 1926; still in service.

Wells

Silver Creek

Number	Year Drilled	Size in.	Depth ft.	Cased
1*	1894	6	120	25
2	1902	8	150	24
3	1902	8	150	24
4	1903	8	257	25
5	1914	8	142	25
6	1914	8	79	25
7	1914	8	174	25
8	1914	8	176	25

Laurel Run

1	1902	8	55	25
2	1909	8	174	25
3	1903	8	198	25
4	1903	8	181	25
5	1909	8	203	25
6	1909	8	171	25
7	1914	8	204	25

* Abandoned because pump room extended over well.

SUMMARY OF CLASS B FACILITIES (contd.)

Wells (contd.)

Wolf Lick Run

Number	Year Drilled	Size in.	Depth ft.	Cased
1	1908	6	112	25
2	1908	8	94	25
3	1908	8	119	25
4	1909	8	278	25
5	1909	6	106	25
6	1909	6	117	25
7	1925	6	107	25

Luhrling Pines

1	1926	6	172	16
2	1926	6	171	17
3	1926	6	203	24
4	1926	6	163	14
5	1926	6	130	22
6	1926	6	130	23

Pumping Equipment

Silver Creek

Type	Capacity mgd.	Year Installed
Plunger, no details *	—	1901
Gas engine	—	1901

* Retired 1927 when new station built.
Salvaged for \$50.

Pumping Equipment (contd.)

Steam pump and boiler †	—	1889
Plunger pump, 10" × 10"	0.573	1915
50-hp. gas engine		
Air compressor, 10" × 18"	—	1914
40-hp. gas engine		

Laurel Run

Type	Capacity mgd.	Year Installed
Plunger pump, 9" × 16"	0.685	1904
100-hp. gas engine		
Plunger pump, 8" × 10"	0.576	1898
75-hp. gas engine		
Air compressor, 11" × 18"	—	1909
40-hp. gas engine		

Wolf Lick Run

Plunger pump, 7½" × 16"	0.870	1907
150-hp. gas engine		
Air compressor ‡	—	1909
30-hp. gas engine		
Air compressor, 14½" × 20"	—	1920
80-hp. gas engine		

Luhrling Pines

Plunger pump, 8" × 12"	0.504	1926
100-hp. gas engine		
Integral air compressor		

† Retired 1901 and replaced by gas power.
‡ Retired 1920. Large compressor salvaged for \$450.

SUMMARY OF INSTALLATIONS AND RETIREMENTS

ST. MARYS, PENNSYLVANIA

MAINS

1-IN. WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1900	305	305	0
1941	0	0	0
TOTAL	305	305	0

1½-IN. WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1900	1,097	347	750
1913	298	298	0
1941	0	0	0
TOTAL	1,395	645	750

Retirements by Years

Year	Feet	Year
Installed		
1900	750	1925

1½-IN. WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1900	261	261	0
1941	0	0	0
TOTAL	261	261	0

2-IN. WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1890	300	300	0
1900	5,419	1,425	3,994
1912	350	350	0
1923	173	173	0
1941	0	0	0
TOTAL	6,242	2,248	3,994

2-IN. WROUGHT-IRON MAINS (contd.)

Retirements by Years

Year	Feet	Year	Feet	Year
<i>Installed</i>				
1900	3,810	1925	184	1938

4-IN. WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	4,300	0	4,300
1900	2,009	1,690	319
1941	0	0	0
TOTAL	6,309	1,690	4,619

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1889	4,300	1897
1900	319	1939

5-IN. WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1900	876	876	0
1941	0	0	0
TOTAL	876	876	0

6-IN. WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1897	4,546	4,390	156
1898	14,862	14,507	355
1900	3,023	3,023	0
1914	101	101	0
1926	82	82	0
1939	355	355	0
1941	0	0	0
TOTAL	22,969	22,458	511

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1897	156	1919
1898	355	1939

4-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1891	21,562	21,441	121
1894	1,400	1,400	0
1897	1,682	1,682	0
1898	760	760	0
1900	450	0	450
1902	3,126	3,126	0
1903	475	475	0
1904	2,259	2,259	0
1905	1,536	1,536	0
1906	3,163	3,163	0
1907	520	520	0
1908	1,641	1,641	0
1909	1,596	1,596	0
1910	287	287	0
1911	643	643	0
1912	2,307	2,307	0
1913	1,914	1,914	0
1914	2,074	2,074	0
1915	766	766	0
1917	196	196	0
1919	2,139	2,139	0
1921	1,847	1,847	0
1922	3,041	3,041	0
1923	711	711	0
1924	2,453	2,453	0
1925	1,441	1,441	0
1926	1,785	1,785	0
1927	1,658	1,658	0
1928	1,111	1,111	0
1941	0	0	0
TOTAL	64,543	63,972	571

Retirements by Years

Year	Feet	Year	Feet
<i>Installed</i>		<i>Installed</i>	
1891	121	1939	
1900	450	1936	

6-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1891	5,612	5,612	0
1896	1,440	1,440	0
1897	2,116	2,116	0
1903	2,647	2,647	0
1907	1,423	1,423	0
1913	4,165	4,165	0
1914	8,487	8,487	0
1923	250	250	0

6-IN. CAST-IRON UNLINED MAINS (contd.)

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1924	641	641	0
1941	0	0	0
TOTAL	26,781	26,781	0

8-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1907	23,481	23,481	0
1941	0	0	0
TOTAL	23,481	23,481	0

2-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	108	108	0
1936	96	96	0
1937	1,004	1,004	0
1938	1,352	1,352	0
1939	3,807	3,807	0
1940	3,433	3,433	0
1941	0	0	0
TOTAL	9,800	9,800	0

4-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	26	26	0
1934	22	22	0
1935	1,044	1,044	0
1936	96	96	0
1937	60	60	0
1938	174	174	0
1941	0	0	0
TOTAL	1,422	1,422	0

6-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1928	660	660	0
1929	789	789	0
1930	795	795	0
1931	801	801	0
1933	2,102	2,102	0
1934	801	801	0

6-IN. CAST-IRON UNLINED MAINS (contd.)

Year	Number		
Installed	Installed	In Service	Retired
1935	1,731	1,731	0
1936	2,686	2,686	0
1939	409	409	0
1941	0	0	0
TOTAL	10,774	10,774	0

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1927	10,107	10,107	0
1941	0	0	0
TOTAL	10,107	10,107	0

METERS

½-IN. DISC METERS

Year	Number		
Installed	Installed	In Service	Retired
1918	207	0	207
1919	500	449	51
1920	250	250	0
1921	24	24	0
1922	24	24	0
1923	24	24	0
1924	39	39	0
1925	30	30	0
1926	46	46	0
1927	30	30	0
1928	48	48	0
1929	39	39	0
1930	209	209	0
1931	120	120	0
1933	6	6	0
1934	115	115	0
1935	65	65	0
1936	55	55	0
1937	10	10	0
SUBTOTAL	1,841	1,583	258
Unknown	148	0	148
TOTAL	1,989	1,583	406

Retirements by Years

Year	Num-	Num-	Num-	Year	Num-	Year
Installed	ber	ber	ber	Year	ber	Year
1918	86	1930	121	1931		
1919	23	1931	14	1932	10	1934
	2	1935	2	1936		

¾-IN. DISC METERS

Year	Number		
Installed	Installed	In Service	Retired
1915	1	0	1
1916	9	0	9
1917	4	0	4
1918	4	0	4
1919	12	12	0
1920	32	32	0
1928	3	3	0
1929	2	2	0
1930	1	1	0
1931	8	8	0
1934	6	6	0
1937	1	1	0
SUBTOTAL	83	65	18
Unknown	29	0	29
TOTAL	112	65	47

Retirements by Years

Year	Num-	Year	Num-	Year	Num-	Year
Installed	ber	Year	ber	Year	ber	Year
1915	1	1935				
1916	3	1931	3	1932	2	1933
	1	1935				
1917	4	1931				
1918	4	1931				

1-IN. DISC METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1914	1	0	1
1919	2	0	2
1920	8	3	5
1924	1	1	0
1926	1	1	0
1928	1	1	0
1929	1	1	0
1930	2	2	0
1931	7	7	0
1932	1	1	0
1933	2	2	0
1936	1	1	0
1937	0	0	0
TOTAL	28	20	8

Retirements by Years

<i>Year</i>				
<i>Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>
1914	1	1930		
1919	2	1931		
1920	4	1931	1	1933

1½-IN. DISC METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1905	3	2	1
1909	1	1	0
1910	2	2	0
1920	1	1	0
1937	0	0	0
TOTAL	7	6	1

Retirements by Years

<i>Year</i>	<i>Num-</i>	
<i>Installed</i>	<i>ber</i>	<i>Year</i>
1905	1	1936

1½-IN. DISC METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1905	1	0	1
1913	2	0	2
1930	1	1	0
1934	3	3	0
1937	0	0	0
SUBTOTAL	7	4	3
Unknown	7	0	7
TOTAL	14	4	10

1½-IN. DISC METERS (contd.)

Retirements by Years

<i>Year</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>
<i>Installed</i>				
1905	1	1930		
1913	1	1934	1	1935

2-IN. DISC METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1920	1	0	1
1923	2	0	2
1925	3	1	2
1933	3	3	0
1937	0	0	0
SUBTOTAL	9	4	5
Unknown	6	0	6
TOTAL	15	4	11

Retirements by Years

<i>Year</i>				
<i>Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>
1920	1	1931		
1923	1	1931	1	1933
1925	2	1936		

3-IN. DISC METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1913	2	1	1
1915	1	0	1
1916	1	0	1
1920	1	1	0
1924	1	1	0
1926	1	1	0
1928	3	3	0
1932	1	1	0
1933	1	1	0
1935	1	1	0
1937	0	0	0
SUBTOTAL	13	10	3
Unknown	1	0	1
TOTAL	14	10	4

Retirements by Years

<i>Year</i>	<i>Num-</i>	
<i>Installed</i>	<i>ber</i>	<i>Year</i>
1913	1	1932
1915	1	1932
1916	1	1932

SURVIVAL AND RETIREMENT

4-IN. CURRENT METERS				6-IN. CURRENT METERS			
Year	Number			Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1914	1	0	1	1914	1	1	0
1928	1	1	0	1937	0	0	0
1937	0	0	0				
TOTAL	2	1	1	TOTAL	1	1	0
<i>Retirements by Years</i>							
Year	Num-		Year				
<i>Installed</i>	<i>ber</i>						
1914	1		1937				

HYDRANTS

4-IN. HYDRANTS

Year	Number			Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	40	27	13	1929	5	5	0
1901	6	1	5	1930	1	1	0
1903	3	3	0	1931	1	1	0
1904	1	1	0	1933	1	1	0
1905	1	1	0	1934	2	2	0
1906	1	1	0	1935	2	2	0
1907	1	1	0	1936	2	2	0
1909	2	2	0	1937	0	0	0
1910	2	2	0				
1912	2	2	0	TOTAL	91	73	18
1913	2	2	0				
1915	3	3	0	<i>Retirements by Years</i>			
1920	1	1	0	Year	Num-	Num-	Num-
1921	4	4	0	<i>Installed</i>	<i>ber</i>	<i>ber</i>	<i>ber</i>
1922	3	3	0	Year		Year	Year
1926	3	3	0	1889	2	1920	3
1928	2	2	0	1901	2	1935	3
						1928	8
						1937	

St. Paul, Minnesota

As of December 31, 1941

THE St. Paul Water Department is the operating medium of the municipal water system serving the city of St. Paul, the adjacent city of West St. Paul, a portion of the city of South St. Paul and several rural communities known as Rosetown, New Canada and a portion of Mendota Township.

St. Paul, the capital city of Minnesota, is located on the northeastern bank of the Mississippi River at about the head of river navigation. Besides being the capital city, St. Paul is the hub for the great railroad systems of the Northwest and has become the commercial and industrial center for that section of the country. It has some of the largest wholesale houses in the country dealing in farm products, groceries, drugs and other commodities. The great stock yards, slaughtering and packing houses of South St. Paul are among the country's largest establishments in that line.

At the time of this study the estimated population of the city proper was 290,000, with some 300,000 being served by the department, supplied through 62,143 active service connections of which 59,657 were metered accounts. The consumption for the year (1941) was 8,904 mil.gal. or an average of 24.4 mgd. This was equivalent to 360 gpd. per tap or 84 gpd. per person, as measured by delivery to the system.

Development of the Existing System

The first plant which supplied water to the city was built by a private company, the St. Paul Water Company, in 1869-70, operating under a state charter granted in 1857. This first plant did not have any reservoirs or pumps and but a few miles of mains. It was not long before the city outgrew the financial ability of the company to keep pace and the citizens decided to secure and operate their own system.

In 1881 the state legislature authorized the city to purchase the private company. The purchase was completed in August 1882 and a Board of Water Commissioners was created to govern the new department. From 1882 to 1914 the members of the board were appointed from representative citizenry; since the new city charter was adopted in 1914 the board has been composed ex officio of the Commissioners of Public Utilities, Public Works and Finance.

The original supply was from Lake Phalen, a small lake located north of the city, and the distribution, entirely by gravity, was through a few miles of cement-covered sheet iron pipe, earthenware pipe and a small amount of cast iron. Upon purchase of the original plant by the city, the board immediately started an expansion program. This program selected as the source of supply a chain of five prin-

TABLE 1
SUMMARY OF MAINS
ST. PAUL, MINNESOTA

Size, in.	Kind	No. of Feet Installed	No. of Feet Identified	Per- cent- age of Total	No. of Feet Retired	Per- cent- age of Total	No. of Feet in Service	Per- cent- age of Total	Year of First Instal- lation	Aver- age Age, yr.
4	Cast- iron unlined	110,076	87,409	2.6	16,630	17.4	70,779	2.1	1882	46.7
6		2,218,762	2,180,386	64.2	44,136	46.2	2,136,250	64.7	1882	33.4
8		174,828	174,828	5.1	2,980	3.1	171,848	5.2	1895	17.7
12		395,635	395,635	11.7	5,949	6.2	389,686	11.8	1883	36.9
16		263,902	263,902	7.8	8,054	8.4	255,848	7.7	1883	37.6
20		66,490	66,490	2.0	2,831	3.0	63,659	1.9	1884	42.8
24		31,992	31,992	0.9	249	0.3	31,743	1.0	1883	37.1
30		61,678	61,678	1.8	0	0.0	61,678	1.9	1884	35.1
36		20,653	20,653	0.6	685	0.7	19,968	0.6	1884	36.2
42		11,237	11,237	0.3	0	0.0	11,237	0.3	1923	18.5
6	Cast- iron (Uni- versal)	62,638	62,638	1.8	0	0.0	62,638	1.9	1931	4.4
8		4,700	4,700	0.1	0	0.0	4,700	0.1	1934	7.5
12		696	696	0.0	0	0.0	696	0.0	1939	2.4
4	Cement	9,814	888	0.0	888	0.9	0	0.0	1882	—
6		5,846	0	0.0	0	0.0	0	0.0	—	—
12		3,640	0	0.0	0	0.0	0	0.0	—	—
16		29,359	6,000	0.2	6,000	6.3	0	0.0	1887	—
24	Gal- vanized iron	14,024	7,024	0.2	7,024	7.4	0	0.0	1885	—
3		1,831	1,831	0.1	100	0.1	1,731	0.1	1921	16.4
20	Steel	8,409	8,409	0.3	0	0.0	8,409	0.3	1938	3.3
24		2,621	2,621	0.1	0	0.0	2,621	0.1	1938	3.5
30		8,014	8,014	0.2	0	0.0	8,014	0.3	1938	3.5
TOTAL		3,506,845	3,397,031	100.0	95,526	100.0	3,301,505	100.0		33.0
Percentage of Total			100.00		2.81		97.19			
Average Size, in.			8.87		9.54		8.85			

Mortality Survival Ratios

Size, in.	Kind	Number of Feet	Period Covered, yr.	Percentage
4	Cast-iron unlined	87,409	59.5	79.636
6		2,243,024	59.5	91.977
8		179,528	46.5	97.931
12		396,331	58.5	98.281
Over 12		455,952	58.5	95.816
4-24	Cement	13,912	35.5	0.000
3	Galvanized iron	1,831	20.5	93.594
20-30	Steel	19,044	3.5	100.000
TOTAL		3,397,031		

TABLE 2
SUMMARY OF METERS
ST. PAUL, MINNESOTA

Size, in.	Kind	Number Purchased	Number Identified Installed	Number Retired	Number in Service	Average Age, yr.
$\frac{5}{8}$	Disc	62,603	58,584	6,756	51,828	19.9
$\frac{3}{4}$		4,745	4,476	388	4,088	11.3
1		3,437	3,144	260	2,884	13.6
$1\frac{1}{4}$		261	256	1	255	27.3
$1\frac{1}{2}$		1,221	1,081	179	902	15.9
2		607	500	75	425	22.1
3		11	11	7	4	25.2
4		4	4	4	0	—
2		50	50	0	50	4.8
3		174	173	53	120	8.1
$\frac{3}{4}$	Compound	119	118	43	75	8.0
6		44	44	18	26	10.8
8		2	2	0	2	5.5
3		19	19	7	12	12.7
$\frac{3}{4}$	Turbine	10	10	3	7	19.5
6		13	13	2	11	17.3
8		1	1	0	1	24.5
TOTAL		73,321	68,486	7,796	60,690	19.0
Percentage of Total			100.00	11.38	88.62	

Mortality Survival Ratios

Size, in.	Kind	Number	Length of Record, yr.	Percentage
$\frac{5}{8}$	Disc	58,584	43.5	15.163
$\frac{3}{4}$ -4	Disc	9,472	38.5	16.243
2-8	Other	430	27.5	11.777
TOTAL		68,486		

Unidentified Meters

Size, in.	Kind	No Record	Stolen	Frozen	Burned	Sold	Total
$\frac{5}{8}$	Disc	3,750	161	48	30	30	4,019
$\frac{3}{4}$		260	7	1	0	1	269
1		276	6	3	0	8	293
$1\frac{1}{4}$		0	0	0	0	5	5
$1\frac{1}{2}$		125	1	12	0	2	140
2		93	4	7	0	3	107
3	Compound	0	0	1	0	0	1
4		0	0	1	0	0	1
TOTAL		4,504	179	73	30	49	4,835

TABLE 3
CAUSES OF RETIREMENT OF CAST-IRON MAINS
ST. PAUL, MINNESOTA

Cause of Retirement	Size			
	4-in.	6-in.	8-in.	12-in.
	Feet Retired			
Inadequate	5,982	12,846		
Replaced	1,326	7,420		
Abandoned	5,428	4,130		
Market construction	821			
Houses moved	364			
Street changes	209	2,598	300	
Sewer construction			100	175
Taken up and relaid		706		
Railroad tank moved				47
Not known	2,500	16,436	2,580	5,727
TOTAL	16,630	44,136	2,980	5,949
Salvaged		1,394		

Cause of Retirement	Size			
	16-in.	20-in.	24-in.	36-in.
	Feet Retired			
Depot construction	720			
Bridge construction	1,940			
River improvement	1,089			
Reservoir construction		60	70	
Replaced	661		154	
Not known	3,644	2,771	25	685
TOTAL	8,054	2,831	249	685
Salvaged	3,123			

cial lakes lying farther north of the city. The supply was augmented from time to time by proceeding further with diversion from other lakes and proved sufficient until 1920. The original supply from Lake Phalen was not abandoned until 1913.

In 1920 it became apparent the supply was becoming insufficient to meet

the rapidly increasing demands. In 1922 the first filtration units were installed and in 1925 a conduit was installed from the Mississippi River to supply the additional amount of water required.

Again in 1936 it was apparent that the existing plant would not be sufficient to supply the growing demand

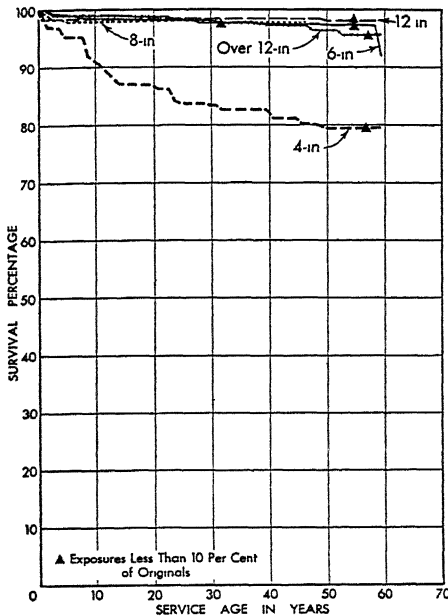


FIG. 1. Mortality Survival Curve—4-42-in. Cast-Iron Unlined Mains—St. Paul, Minnesota

BASE: Feet		SURVIVAL: 1882-1941	
SIZE	EXPOSURES	RETIREMENTS	
in.	ft.	ft.	
4	87,409	16,630	
6	2,243,024	44,136	
8	179,528	2,980	
12	396,331	5,949	
Over 12	455,952	11,819	

and in 1937-40 extensions to the plant were made, including the addition of a softening plant, which brought the total capacity to 70 mgd.

Lakes Vadnais, Pleasant, Otter, Charles and Sucker form the principal impounding reservoirs of the present water supply system. The Centerville Lake system, consisting of four principal lakes, forms a second source which is pumped to the Vadnais reservoir system. As a third, and reserve source of supply, water from Otter and Bald Eagle Lake is diverted by gravity into the Vadnais system. The

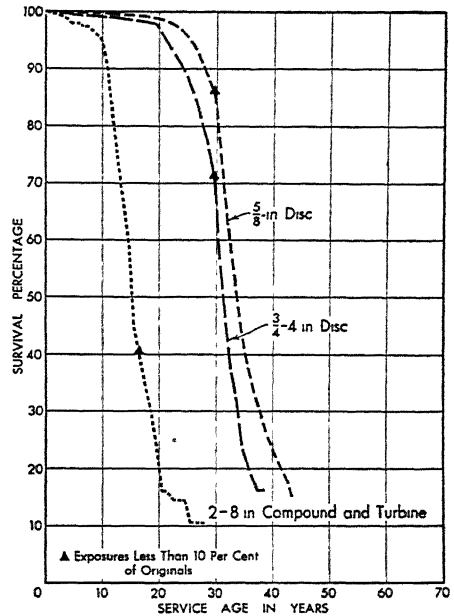


FIG. 2. Mortality Survival Curve— $\frac{5}{8}$ -8-in. Meters—St. Paul, Minnesota

BASE:		SURVIVAL:	
Unit		1898-1941	
SIZE	KIND	EXPOSURES	RETIREMENTS
in.		Units	Units
$\frac{5}{8}$	Disc	58,584	6,756
$\frac{3}{4}$ -4	Disc	9,472	914
2-8	Compound and Turbine	430	126

Mississippi River near Fridley, several miles north of Minneapolis, forms one of the principal sources at the present time, being pumped through a 60-in. conduit to Charles Lake of the Vadnais system.

The filtration plant has a nominal capacity of 70 mgd. The purification works settle, soften, filter and sterilize all water now used. The main pumping station, the McCarron Pumping Station, adjacent to the purification works, pumps to three services, the low, the Dale and Snelling high services. All have considerable storage

located in reservoirs therein, totaling about 65 mil.gal. Several small high areas are supplied through booster service.

Basis of Study

The data used in the study were taken from the annual reports, which are complete from 1882, and from other department records. Most of the pipe installed prior to 1882 was in active service at the date of acquisition. Much of the original cast-iron pipe is still in service but is not used in the mortality study because the dates of installation are not known.

The records of meter and service installations and retirements are complete from the date of acquisition by the city in 1882.

Mortality Survival Study

Mortality survival studies were made of mains and meters. Table 1 is a summary of the distribution pipe installed and retired as well as other pertinent data. Table 2 is a summary

of the meter records studies. Figures 1 and 2 show the mortality survival curves of the respective facilities.

A mortality study of services could not be carried out by the department at the present time.

Causes of Retirement

From the old annual reports it was possible to determine in many cases the causes of the retirements. So far as these could be determined, they are shown in Table 3.

Acknowledgments

The collection and compilation of data pertaining to the study in St. Paul were made possible through the efforts of the late John C. Flanagan, Registrar of the St. Paul Water Department and a member of the Committee on Survival and Retirement Experience With Water Works Facilities. The research and tabulation were carried on by the regular staff of the Engineering Department under the encouragement of the Board of Water Commissioners and the personal supervision of Leonard N. Thompson, General Manager.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
ST. PAUL, MINNESOTA

MAINS

4-IN. CAST-IRON UNLINED MAINS

<i>Year</i>				<i>Year</i>			
<i>Feet</i>				<i>Feet</i>			
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1882	742	738	4	1912	739	530	209
1883	4,494	925	3,569	1913	607	607	0
1884	2,470	2,470	0	1914	735	735	0
1885	9,142	7,109	2,033	1915	137	137	0
1886	9,069	5,069	4,000	1919	235	235	0
1887	10,922	5,323	5,599	1920	324	324	0
1888	7,932	7,932	0	1921	1,768	1,768	0
1889	10,661	10,294	367	1922	670	670	0
1890	5,927	5,563	364	1923	1,350	1,350	0
1891	2,072	2,072	0	1924	946	783	163
1892	1,225	1,211	14	1927	287	287	0
1893	5,019	5,019	0	1929	54	54	0
1894	1,179	1,179	0	1930	993	993	0
1895	920	920	0	1932	210	210	0
1896	412	108	304	1933	1,447	1,447	0
1897	387	387	0	1936	834	834	0
1898	264	260	4	1937	129	129	0
1900	310	310	0	1941	0	0	0
1902	326	326	0				
1903	636	636	0	SUBTOTAL	87,409	70,779	16,630
1906	289	289	0	Unknown	22,667	10,701	11,966
1908	1,002	1,002	0				
1910	250	250	0	TOTAL	110,076	81,480	28,596
1911	294	294	0				

Retirements by Years

<i>Year</i>								<i>Year</i>							
<i>Installed Feet</i>								<i>Installed Feet</i>							
<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1882	4	1897						1887	1,332	1910	240	1936			
1883	1,366	1887	770	1895	550	1896		1889	367	1929					
	397	1897	486	1903				1890	364	1930					
1885	370	1895	14	1897	392	1909		1892	14	1897					
	50	1913	304	1925	658	1930		1896	192	1925	112	1936			
	245	1932						1898	4	1898					
1886	1,893	1887	523	1895	1,030	1897		1912	209	1935					
	554	1917						1924	163	1931					
1887	526	1887	3,489	1895	12	1897									

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i>				<i>Year</i>			
<i>Feet</i>				<i>Feet</i>			
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1882	14,682	5,870	8,812	1885	76,807	72,722	4,085
1883	20,299	16,898	3,401	1886	72,249	64,084	8,165
1884	27,187	21,873	5,314	1887	88,185	85,494	2,691

SURVIVAL AND RETIREMENT

6-IN. CAST-IRON UNLINED MAINS (contd.)

Year	Feet			Year	Feet		
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1888	87,178	84,344	2,834	1918	41,405	41,405	0
1889	109,157	108,219	938	1919	27,440	26,262	1,178
1890	106,344	105,594	750	1920	32,024	32,024	0
1891	23,799	23,799	0	1921	43,965	43,965	0
1892	43,173	43,173	0	1922	50,490	50,490	0
1893	29,322	29,322	0	1923	57,310	56,446	864
1894	30,674	30,674	0	1924	73,893	73,893	0
1895	24,781	24,275	506	1925	52,094	51,661	433
1896	7,835	7,835	0	1926	43,346	43,346	0
1897	11,192	11,192	0	1927	57,928	57,928	0
1898	12,388	12,388	0	1928	42,322	42,290	32
1899	13,216	13,216	0	1929	34,636	34,636	0
1900	17,305	17,305	0	1930	32,414	32,089	325
1901	15,322	15,322	0	1931	7,911	7,911	0
1902	18,463	18,463	0	1932	1,771	1,771	0
1903	26,516	26,516	0	1933	1,884	1,884	0
1904	22,417	22,417	0	1934	1,894	1,894	0
1905	22,255	21,775	480	1935	1,689	1,689	0
1906	37,904	36,600	1,304	1936	9,436	9,436	0
1907	52,115	50,851	1,264	1937	6,668	6,668	0
1908	52,661	52,661	0	1938	3,390	3,390	0
1909	60,433	60,381	52	1939	15,967	15,967	0
1910	50,823	50,823	0	1940	2,145	2,145	0
1911	41,332	41,332	0	1941	6,371	6,371	0
1912	39,439	39,439	0				
1913	44,314	43,682	632	SUB-			
1914	63,869	63,869	0	TOTAL	2,180,386	2,136,250	44,136
1915	69,369	69,293	76	Unknown	38,376	24,770	13,606
1916	56,764	56,764	0				
1917	42,224	42,224	0	TOTAL	2,218,762	2,161,020	57,742

Retirements by Years

[illegible]

8-IN. CAST-IRON UNLINED MAINS

<i>Year</i>				<i>Year</i>			
<i>Installed</i>	<i>Feet</i>			<i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1895	2,643	2,643	0	1926	8,379	8,379	0
1896	768	768	0	1927	9,397	9,397	0
1897	3,385	3,385	0	1928	13,312	13,312	0
1899	658	658	0	1929	3,959	3,959	0
1901	376	376	0	1930	6,280	6,280	0
1903	1,832	1,832	0	1931	12,580	12,580	0
1905	2,103	2,103	0	1932	2,359	2,359	0
1907	1,281	1,181	100	1933	2,030	2,030	0
1908	1,423	1,423	0	1934	2,740	2,740	0
1909	696	696	0	1935	208	208	0
1910	5,255	5,255	0	1936	2,048	2,048	0
1911	840	840	0	1937	2,182	2,182	0
1913	351	351	0	1938	5,434	5,434	0
1914	3,485	3,485	0	1939	650	650	0
1915	480	480	0	1940	687	687	0
1916	3,207	3,207	0	1941	2,465	2,465	0
1917	2,280	2,280	0				
1918	537	537	0	TOTAL	174,828	171,848	2,980
1919	1,601	1,601	0				
1920	5,682	5,682	0	<i>Retirements by Years</i>			
1921	2,032	2,032	0	<i>Year</i>			
1922	10,973	10,973	0	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1923	21,313	18,733	2,580	1907	100	1935	
1924	12,992	12,992	0	1923	2,580	1923	
1925	13,925	13,625	300	1924	300	1929	

12-IN. CAST-IRON UNLINED MAINS

<i>Year</i>				<i>Year</i>			
<i>Installed</i>	<i>Feet</i>			<i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1883	2,445	2,445	0	1906	4,069	4,069	0
1884	9,200	9,200	0	1907	15,816	15,641	175
1885	12,643	9,383	3,260	1908	11,500	11,453	47
1886	14,146	12,168	1,978	1909	12,975	12,975	0
1887	27,071	27,071	0	1910	10,179	10,179	0
1888	27,567	27,557	10	1911	1,590	1,590	0
1889	25,535	25,511	24	1912	6,634	6,634	0
1890	14,890	14,435	455	1913	4,103	4,103	0
1891	3,997	2,997	0	1914	13,285	13,285	0
1892	15,388	15,388	0	1915	5,475	5,475	0
1893	9,445	9,445	0	1916	2,803	2,803	0
1894	4,084	4,084	0	1917	5,687	5,687	0
1895	4,992	4,992	0	1918	2,091	2,091	0
1896	2,363	2,363	0	1919	3,466	3,466	0
1897	2,118	2,118	0	1920	7,777	7,777	0
1899	270	270	0	1921	1,806	1,806	0
1900	2,739	2,739	0	1922	4,703	4,703	0
1901	4,185	4,185	0	1923	7,274	7,274	0
1902	2,028	2,028	0	1924	8,283	8,283	0
1903	8,208	8,208	0	1925	10,171	10,171	0
1904	2,957	2,957	0	1926	5,620	5,620	0
1905	9,494	9,494	0	1927	6,007	6,007	0

SURVIVAL AND RETIREMENT

12-IN. CAST-IRON UNLINED MAINS (contd.)

Year				Year			
		Feet				Feet	
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1928	4,427	4,427	0	1937	500	500	0
1929	3,773	3,773	0	1938	550	550	0
1930	8,138	8,138	0	1939	4,136	4,136	0
1931	7,239	7,239	0	1940	556	556	0
1932	5,932	5,932	0	1941	2,000	2,000	0
1933	84	84	0				
1935	210	210	0	TOTAL	395,635	389,686	5,949
1936	1,011	1,011	0				

Retirements by Years

Year			Year		
Installed	Feet	Year	Installed	Feet	Year
1885	3,260	1887	1890	455	1939
1886	1,978	1887	1907	175	1935
1888	10	1897	1908	47	1911
1889	24	1895			

16-IN. CAST-IRON UNLINED MAINS

Year				Year			
		Feet				Feet	
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1883	2,137	2,137	0	1918	1,608	1,608	0
1884	7,679	7,679	0	1919	1,651	1,651	0
1885	24,845	21,251	3,594	1920	6,088	6,088	0
1886	5,410	5,410	0	1921	2,150	2,150	0
1887	14,107	12,442	1,665	1922	4,316	4,316	0
1888	6,081	6,081	0	1923	12,213	12,213	0
1889	31,511	31,511	0	1924	16,378	16,184	194
1890	15,890	15,890	0	1925	1,938	1,938	0
1892	13,320	13,320	0	1926	10,792	10,792	0
1894	2,991	2,991	0	1927	8,011	8,011	0
1895	12	12	0	1928	1,077	1,077	0
1897	324	324	0	1929	3,613	3,613	0
1898	524	524	0	1930	1,000	1,000	0
1899	312	312	0	1931	3,412	3,412	0
1900	3,236	3,236	0	1932	940	940	0
1902	794	794	0	1933	84	84	0
1903	977	977	0	1936	80	80	0
1904	8,351	8,351	0	1941	885	885	0
1905	1,983	1,983	0				
1906	2,711	2,050	661	TOTAL	263,902	255,848	8,054
1907	1,436	1,436	0				
1908	9,501	7,561	1,940				
1909	7,591	7,591	0				
1910	7,594	7,594	0				
1911	1,280	1,280	0				
1912	2,223	2,223	0				
1913	3,490	3,490	0				
1914	3,392	3,392	0				
1915	2,658	2,658	0				
1916	3,736	3,736	0				
1917	1,570	1,570	0				

Retirements by Years

Year							
Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1885	3,594	1887					
1887	50	1897	161	1918	211	1924	
	1,243	1939					
1906	661	1931					
1908	1,940	1931					
1924	194	1939					

20-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1884	10,973	8,202	2,771
1885	4,642	4,642	0
1886	1,415	1,415	0
1887	4,795	4,795	0
1888	16,067	16,067	0
1889	4,585	4,585	0
1892	1,716	1,656	60
1895	12	12	0
1896	46	46	0
1897	27	27	0
1898	60	60	0
1905	6,555	6,555	0
1923	1,318	1,318	0
1924	1,195	1,195	0
1925	903	903	0
1926	1,756	1,756	0
1927	24	24	0
1929	1,865	1,865	0
1930	2,650	2,650	0
1932	1,912	1,912	0
1936	2,700	2,700	0
1939	924	924	0
1941	350	350	0
TOTAL	66,490	63,659	2,831

Retirements by Years

Year	Feet		Year	Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1884	650	1923	2,121	1931	
1892	60	1898			

24-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1883	25	25	0
1884	11,807	11,628	179
1887	50	50	0
1888	3,013	3,013	0
1889	2,235	2,235	0
1891	88	18	70
1895	18	18	0
1898	46	46	0
1912	3,844	3,844	0
1924	60	60	0
1925	2,724	2,724	0
1930	30	30	0
1931	3,900	3,900	0
1936	4,100	4,100	0
1941	52	52	0
TOTAL	31,992	31,743	249

Retirements by Years

Year	Feet	Year	Feet	Year
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1884	25	1897	154	1898
1891	70	1898		

30-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1884	16,436	16,436	0
1895	9,234	9,234	0
1898	841	841	0
1912	10,391	10,391	0
1922	3,030	3,030	0
1923	15,018	15,018	0
1925	4,080	4,080	0
1926	2,600	2,600	0
1936	48	48	0
1941	0	0	0
TOTAL	61,678	61,678	0

36-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1884	18	18	0
1888	1,560	1,560	0
1896	7,353	6,668	685
1897	33	33	0
1898	154	154	0
1912	10,392	10,392	0
1923	1,143	1,143	0
1941	0	0	0
TOTAL	20,653	19,968	685

Retirements by Years

Year	Feet	Year
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1896	685	1923

42-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1923	11,237	11,237	0
1941	0	0	0
TOTAL	11,237	11,237	0

6-IN. CAST-IRON UNIVERSAL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1931	6,385	6,385	0
1932	8,487	8,487	0
1933	1,553	1,553	0
1934	1,581	1,581	0
1936	1,836	1,836	0
1937	4,794	4,794	0
1938	10,324	10,324	0
1939	2,639	2,639	0
1940	13,852	13,852	0
1941	11,187	11,187	0
TOTAL	62,638	62,638	0

8-IN. CAST-IRON UNIVERSAL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1934	4,700	4,700	0
1941	0	0	0
TOTAL	4,700	4,700	0

12-IN. CAST-IRON UNIVERSAL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1939	582	582	0
1940	114	114	0
1941	0	0	0
TOTAL	696	696	0

4-IN. CEMENT MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1882	888	0	888
1941	0	0	0
SUBTOTAL	888	0	888
Unknown	8,926	0	8,926
TOTAL	9,814	0	9,814

Retirements by Years

Year						
Installed	Feet	Year	Feet	Year	Feet	Year
1882	42	1896	300	1900	546	1903

6-IN. CEMENT MAINS

Year	Feet		
Installed	Installed	In Service	Retired
Unknown	5,846	0	5,846
TOTAL	5,846	0	5,846

12-IN. CEMENT MAINS

Year	Feet		
Installed	Installed	In Service	Retired
Unknown	3,640	0	3,640
TOTAL	3,640	0	3,640

16-IN. CEMENT MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1887	6,000	0	6,000
1941	0	0	0
SUBTOTAL	6,000	0	6,000
Unknown	23,359	0	23,359
TOTAL	29,359	0	29,359

Retirements by Years

Year		
Installed	Feet	Year
1887	6,000	1920

24-IN. CEMENT MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1885	7,024	0	7,024
1941	0	0	0
SUBTOTAL	7,024	0	7,024
Unknown	7,000	0	7,000
TOTAL	14,024	0	14,024

Retirements by Years

Year		
Installed	Feet	Year
1885	7,024	1920

3-IN. GALVANIZED-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1921	478	378	100
1926	1,083	1,083	0
1927	270	270	0
1941	0	0	0
TOTAL	1,831	1,731	100

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1921	100	1936

20-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	6,635	6,635	0
1939	1,774	1,774	0
1941	0	0	0
TOTAL	8,409	8,409	0

24-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	2,621	2,621	0
1941	0	0	0
TOTAL	2,621	2,621	0

30-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	8,014	8,014	0
1941	0	0	0
TOTAL	8,014	8,014	0

METERS

½-IN. DISC METERS

Year	Number			Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1898	648	121	527	1922	2,877	2,874	3
1899	449	65	384	1923	993	991	2
1900	529	60	469	1924	993	989	4
1901	558	56	502	1926	196	196	0
1902	561	125	436	1928	223	223	0
1903	408	139	269	1929	491	491	0
1904	430	142	288	1930	1,498	1,496	2
1905	689	172	517	1931	201	201	0
1906	876	233	643	1932	100	100	0
1907	671	260	411	1933	39	38	1
1908	616	234	382	1934	202	202	0
1909	773	292	481	1935	466	466	0
1910	1,160	419	741	1936	667	667	0
1911	750	289	461	1937	674	674	0
1912	13,006	12,848	158	1938	397	397	0
1914	10	6	4	1939	101	101	0
1915	2,475	2,466	9	1940	359	359	0
1916	1,985	1,978	7	1941	415	415	0
1917	21	13	8				
1918	1,500	1,476	24	SUBTOTAL	41,926	35,182	6,744
1919	420	420	0	Unknown	3,963	0	3,963
1920	1,481	1,474	7				
1921	1,018	1,014	4	TOTAL	45,889	35,182	10,707

SURVIVAL AND RETIREMENT

 $\frac{5}{8}$ -IN. DISC METERS (contd.)

Retirements by Years

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1898	1	1916	2	1929	47	1930	1904	16	1939	13	1940	15	1941
	168	1931	126	1932	25	1933	1905	1	1923	2	1929	73	1930
	13	1934	25	1935	31	1936		70	1931	51	1932	48	1933
	20	1937	18	1938	9	1939		28	1934	40	1935	54	1936
	14	1940	28	1941				42	1937	26	1938	23	1939
1899	2	1913	5	1914	4	1915		34	1940	25	1941		
	8	1916	6	1917	6	1918	1906	2	1929	60	1930	48	1931
	1	1919	4	1920	4	1921		44	1932	57	1933	45	1934
	19	1922	12	1923	13	1924		78	1935	76	1936	83	1937
	3	1925	1	1926	3	1927		47	1938	26	1939	43	1940
	6	1928	6	1929	34	1930		34	1941				
	65	1931	78	1932	14	1933	1907	1	1924	3	1929	18	1930
	8	1934	12	1935	20	1936		12	1931	11	1932	22	1933
	16	1937	5	1938	10	1939		19	1934	59	1935	71	1936
	11	1940	7	1941				68	1937	28	1938	28	1939
1900	5	1913	11	1914	5	1915		34	1940	37	1941		
	14	1916	8	1917	13	1918	1908	1	1929	11	1930	7	1931
	3	1919	1	1920	4	1921		16	1932	25	1933	22	1934
	9	1922	27	1923	15	1924		43	1935	59	1936	73	1937
	10	1925	12	1926	10	1927		34	1938	20	1939	40	1940
	12	1928	18	1929	43	1930		31	1941				
	62	1931	82	1932	22	1933	1909	3	1929	15	1930	16	1931
	7	1934	7	1935	22	1936		13	1932	18	1933	36	1934
	15	1937	13	1938	6	1939		68	1935	68	1936	69	1937
	5	1940	8	1941				39	1938	33	1939	49	1940
1901	8	1913	9	1914	8	1915		54	1941				
	23	1916	7	1917	7	1918	1910	1	1929	27	1930	37	1931
	4	1919	3	1920	4	1921		35	1932	44	1933	40	1934
	19	1922	31	1923	8	1924		78	1935	111	1936	108	1937
	2	1925	2	1927	3	1928		79	1938	50	1939	68	1940
	1	1929	40	1930	97	1931		63	1941				
	106	1932	13	1933	11	1934	1911	21	1930	9	1931	16	1932
	16	1935	29	1936	14	1937		11	1933	15	1934	84	1935
	10	1938	10	1939	9	1940		56	1936	77	1937	44	1938
	8	1941						35	1939	40	1940	53	1941
1902	1	1913	6	1914	5	1915	1912	6	1913	8	1914	12	1915
	7	1916	4	1917	4	1918		3	1916	5	1917	1	1918
	3	1919	2	1920	3	1921		2	1919	2	1920	2	1922
	10	1922	18	1923	4	1924		4	1923	4	1924	2	1925
	1	1925	1	1926	2	1928		6	1926	6	1927	47	1928
	1	1929	53	1930	42	1931		3	1929	6	1930	3	1931
	66	1932	37	1933	18	1934		13	1932	5	1933	6	1934
	19	1935	30	1936	25	1937		4	1935	4	1936	1	1937
	20	1938	14	1939	20	1940		2	1939	1	1940		
	20	1941					1914	1	1927	1	1930	1	1932
								1	1935				
1903	41	1930	24	1931	31	1932	1915	2	1924	3	1928	3	1932
	32	1933	21	1934	12	1935		1	1934	1	1941		
	14	1936	33	1937	24	1938	1916	2	1923	1	1931	2	1932
	14	1939	17	1940	6	1941		1	1941				
1904	26	1930	31	1931	22	1932	1917	4	1917	1	1924	2	1929
	26	1933	21	1934	29	1935		1	1940				
	27	1936	42	1937	20	1938							

$\frac{5}{8}$ -IN. DISC METERS (contd.)

Retirements by Years (contd.)

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Year</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	
1918	2	1919	1	1920	2	1922	1921	1	1925	2	1929	1	1937
	2	1923	3	1924	5	1925	1922	2	1927	1	1928		
	4	1926	1	1928	1	1930	1923	1	1929	1	1933		
	1	1931	1	1934	1	1941	1924	1	1928	2	1929	1	1936
1920	2	1923	1	1924	1	1925	1930	1	1933	1	1935		
	2	1931	1	1934			1933	1	1935				

 $\frac{3}{4}$ -IN. DISC METERS

Year Installed	Number			Year Installed	Number		
Installed	In Service	Retired	Installed	In Service	Retired		
1921	2	2	0	1940	308	308	0
1922	1,997	1,996	1	1941	465	465	0
1924	2,490	2,488	2				
1925	3,387	3,380	7	SUBTOTAL	16,658	16,646	12
1926	799	799	0	Unknown	56	0	56
1927	1,189	1,188	1				
1928	998	997	1	TOTAL	16,714	16,646	68
1929	996	996	0				
1930	718	718	0				
1931	197	197	0				
1932	167	167	0				
1933	189	189	0				
1934	120	120	0				
1935	350	350	0				
1936	460	460	0				
1937	1,175	1,175	0				
1938	150	150	0				
1939	501	501	0				

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1922	1	1928				
1924	2	1930				
1925	1	1925	1	1930	1	1934
	1	1935	3	1936		
1927	1	1934				
1928	1	1930				

 $\frac{1}{2}$ -IN. DISC METERS

Year Installed	Number			Year Installed	Number		
Installed	In Service	Retired	Installed	In Service	Retired		
1903	19	4	15	1929	24	24	0
1904	13	2	11	1930	67	67	0
1905	28	2	26	1931	164	164	0
1906	33	7	26	1932	50	50	0
1907	35	3	32	1933	76	76	0
1908	63	4	59	1934	119	119	0
1909	94	20	74	1935	60	60	0
1910	52	5	47	1936	57	57	0
1911	80	21	59	1937	52	52	0
1912	38	2	36	1938	15	15	0
1913	399	397	2	1939	155	155	0
1915	300	300	0	1940	811	811	0
1916	298	297	1	1941	960	960	0
1918	301	301	0				
1921	1	1	0	SUBTOTAL	4,476	4,088	388
1923	100	100	0	Unknown	269	0	269
1925	1	1	0				
1927	1	1	0	TOTAL	4,745	4,088	657
1928	10	10	0				

SURVIVAL AND RETIREMENT

 $\frac{1}{4}$ -IN. DISC METERS (contd.)*Retirements by Years*

<i>Year Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>	<i>Year Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>
1903	1	1930	2	1931	1	1932		4	1940				
	2	1934	1	1935	3	1936	1909	10	1930	14	1931	3	1932
	3	1937	1	1938	1	1940		7	1933	6	1934	5	1935
1904	1	1930	1	1931	3	1932		6	1936	10	1937	3	1938
	1	1933	2	1935	2	1937		4	1939	4	1940	2	1941
	1	1940					1910	2	1930	7	1931	8	1932
1905	1	1925	1	1927	1	1928		6	1933	4	1934	6	1935
	1	1929	1	1930	4	1931		3	1936	3	1937	1	1938
	6	1932	4	1933	4	1934		1	1939	4	1940	2	1941
	1	1936	1	1937	1	1939	1911	3	1930	10	1931	6	1932
1906	1	1923	1	1930	4	1931		4	1933	7	1934	2	1935
	9	1932	2	1933	1	1934		8	1936	8	1937	5	1938
	1	1935	3	1936	3	1937		5	1940	1	1941		
	1	1940					1912	1	1913	1	1914	2	1915
1907	5	1931	2	1932	4	1933		1	1916	3	1918	1	1919
	6	1934	2	1935	2	1936		2	1920	2	1925	2	1926
	2	1937	3	1938	3	1939		5	1928	1	1929	1	1930
	1	1940	2	1941				12	1932	2	1936		
1908	4	1930	8	1931	11	1932	1913	1	1935	1	1939		
	8	1933	2	1934	6	1935	1916	1	1938				
	4	1936	11	1937	1	1939							

1-IN. DISC METERS

<i>Year Installed</i>	<i>Number</i>			<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1903	23	5	18	1927	100	100	0
1904	23	2	21	1928	20	20	0
1905	13	5	8	1929	74	74	0
1906	22	3	19	1930	150	150	0
1907	26	2	24	1931	98	98	0
1908	45	6	39	1932	49	49	0
1909	37	14	23	1934	10	10	0
1910	57	9	48	1935	45	45	0
1911	34	11	23	1936	145	145	0
1912	346	313	33	1937	115	115	0
1913	105	105	0	1938	200	200	0
1915	74	73	1	1939	205	205	0
1918	163	160	3	1940	220	220	0
1920	6	6	0	1941	165	165	0
1922	110	110	0				
1923	104	104	0	SUBTOTAL	3,144	2,884	260
1924	212	212	0	Unknown	293	0	293
1925	50	50	0				
1926	98	98	0	TOTAL	3,437	2,884	553

Retirements by Years

<i>Year Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>	
1903	3	1930	2	1931	6	1932	1904	2	1930	2	1931	1	1932
	2	1933	1	1934	2	1937		2	1933	1	1934	2	1935
	2	1938						6	1936	1	1937	1	1938

1-IN. DISC METERS (contd.)

Retirements by Years (contd.)

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
	1	1939	1	1940	1	1941	1909	1	1939	2	1940	3	1941
1905	1	1930	2	1931	2	1932	1910	3	1930	9	1931	6	1932
	1	1933	1	1937	1	1939		4	1933	3	1934	3	1935
1906	2	1930	6	1931	1	1932		7	1936	7	1937	2	1938
	4	1933	1	1934	2	1935		1	1939	3	1940		
	1	1936	1	1940	1	1941	1911	1	1923	1	1930	5	1931
1907	3	1930	2	1931	3	1932		1	1932	2	1933	2	1934
	3	1933	1	1934	6	1935		1	1935	7	1936	1	1938
	1	1936	3	1937	1	1939		2	1939				
	1	1940					1912	1	1913	5	1914	1	1915
1908	3	1930	3	1931	6	1932		1	1919	1	1921	1	1922
	6	1933	1	1934	3	1935		4	1924	1	1925	1	1926
	2	1936	6	1937	2	1938		2	1927	2	1929	11	1932
	4	1939	2	1940	1	1941		1	1935	1	1939		
1909	6	1930	4	1931	2	1933	1915	1	1932				
	1	1934	1	1936	3	1938	1918	3	1933				

1½-IN. DISC METERS

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1912	143	143	0	Unknown	5	0	5
1915	30	30	0				
1917	69	68	1	TOTAL	261	255	6
1920	6	6	0				
1923	8	8	0				
1941	0	0	0				
SUBTOTAL	256	255	1				

Retirements by Years

Year Installed	Number	Year
1917	1	1929

1½-IN. DISC METERS

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1903	9	0	9	1927	49	49	0
1904	10	0	10	1929	10	10	0
1905	3	0	3	1930	75	75	0
1906	5	0	5	1931	54	54	0
1907	14	0	14	1932	30	30	0
1908	32	0	32	1933	5	5	0
1909	17	1	16	1934	10	10	0
1910	25	0	25	1935	27	27	0
1911	24	0	24	1937	40	40	0
1912	126	87	39	1938	60	60	0
1915	15	15	0	1939	20	20	0
1917	60	59	1	1941	0	0	0
1921	18	18	0				
1922	161	160	1	SUBTOTAL	1,081	902	179
1923	73	73	0	Unknown	140	0	140
1924	61	61	0				
1926	48	48	0	TOTAL	1,221	902	319

SURVIVAL AND RETIREMENT

1½-IN. DISC METERS (contd.)

Retirements by Years

<i>Year Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>
1903	1	1932	2	1933	5	1909	2	1938				
	1	1939				1910	3	1931	5	1932	2	1934
1904	1	1930	1	1931	2		4	1935	1	1936	6	1938
	1	1933	1	1934	2		2	1939	2	1940		
	2	1938				1911	4	1931	3	1933	1	1935
1905	1	1933	2	1935			1	1936	1	1937	13	1938
1906	1	1930	2	1931	2		1	1939				
1907	1	1930	2	1931	1	1912	2	1913	2	1914	2	1917
	6	1935	1	1937	2		1	1919	1	1920	2	1922
	1	1939					1	1923	1	1924	2	1925
1908	4	1930	3	1931	1		6	1929	4	1931	13	1932
	1	1933	5	1935	2		1	1934	1	1940		
	9	1937	7	1938		1917	1	1932				
1909	2	1930	4	1931	2	1922	1	1935				
	1	1934	3	1935	2							

2-IN. DISC METERS

<i>Year Installed</i>	<i>Number</i>			<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1903	1	0	1	1919	19	18	1
1904	2	0	2	1922	103	102	1
1905	5	0	5	1924	25	25	0
1906	3	0	3	1927	24	24	0
1907	7	0	7	1928	25	25	0
1908	12	0	12	1930	28	28	0
1909	11	1	10	1936	10	10	0
1910	10	0	10	1941	0	0	0
1911	5	0	5				
1912	75	63	12	SUBTOTAL	500	425	75
1913	110	107	3	Unknown	107	0	107
1915	19	16	3				
1917	6	6	0	TOTAL	607	425	182

Retirements by Years

<i>Year Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>
1903	1	1932				1910	1	1930	1	1932	3	1933
1904	1	1933	1	1935			1	1935	1	1938	3	1940
1905	1	1929	1	1933	1	1911	1	1919	1	1931	1	1932
	1	1937	1	1939			1	1933	1	1936		
1906	1	1934	1	1935	1	1912	1	1914	1	1916	1	1919
1907	1	1930	3	1931	1		1	1923	1	1924	4	1929
	1	1935	1	1940			2	1932	1	1935		
1908	1	1933	3	1935	7	1913	1	1932	1	1934	1	1936
	1	1939				1915	1	1930	1	1931	1	1940
1909	1	1930	1	1933	2	1919	1	1932				
	2	1935	1	1936	1	1922	1	1936				
	1	1939	1	1940								

3-IN. DISC METERS

Year	Number		
Installed	Installed	In Service	Retired
1913	1	1	0
1914	1	1	0
1916	2	1	1
1917	2	0	2
1918	4	0	4
1922	1	1	0
1941	0	0	0
TOTAL	11	4	7

Retirements by Years

Year	Num-	Num-	Num-	Year
Installed	ber	ber	ber	Year
1916	1	1933		
1917	1	1927	1	1930
1918	1	1929	1	1931
	1	1934	1	1933

4-IN. DISC METERS

Year	Number		
Installed	Installed	In Service	Retired
1912	2	0	2
1916	1	0	1
1917	1	0	1
1941	0	0	0
TOTAL	4	0	4

Retirements by Years

Year	Number	Year	Number	Year
Installed				
1912	1	1932	1	1940
1916	1	1930		
1917	1	1933		

2-IN. COMPOUND METERS

Year	Number		
Installed	Installed	In Service	Retired
1931	2	2	0
1932	2	2	0
1933	6	6	0
1934	1	1	0
1935	6	6	0
1936	10	10	0
1937	5	5	0
1939	4	4	0
1940	6	6	0
1941	8	8	0
TOTAL	50	50	0

3-IN. COMPOUND METERS

Year	Number		
Installed	Installed	In Service	Retired
1916	2	0	2
1920	6	0	6
1921	6	0	6
1922	6	0	6
1923	5	0	5
1924	6	0	6
1925	11	2	9
1926	6	5	1
1927	1	1	0
1928	13	8	5
1929	9	3	6
1930	16	15	1
1931	9	9	0
1932	15	15	0
1933	7	7	0
1934	7	7	0
1935	7	7	0
1936	8	8	0
1937	6	6	0
1938	7	7	0
1939	10	10	0
1940	9	9	0
1941	1	1	0
SUBTOTAL	173	120	53
Unknown	1	0	1
TOTAL	174	120	54

Retirements by Years

Year	Num-	Num-	Num-	Year
Installed	ber	ber	ber	Year
1916	1	1932	1	1933
1920	2	1931	1	1935
	1	1939	1	1940
1921	3	1935	2	1936
1922	1	1932	1	1934
	1	1936	1	1937
1923	2	1935	1	1938
	1	1940		
1924	1	1933	1	1935
	1	1937	1	1938
1925	1	1935	4	1936
	2	1939	1	1940
1926	1	1938		
1928	1	1931	1	1936
	2	1940		
1929	1	1931	1	1932
1930	1	1940		

4-IN. COMPOUND METERS

Year Installed	Number		
	Installed	In Service	Retired
1915	3	0	3
1918	1	0	1
1919	4	0	4
1920	12	0	12
1922	4	3	1
1923	5	0	5
1925	6	0	6
1926	9	3	6
1927	6	2	4
1928	6	5	1
1929	1	1	0
1930	5	5	0
1931	6	6	0
1932	6	6	0
1933	3	3	0
1934	6	6	0
1935	6	6	0
1936	6	6	0
1937	6	6	0
1938	4	4	0
1939	7	7	0
1940	5	5	0
1941	1	1	0
<hr/>			
SUBTOTAL	118	75	43
Unknown	1	0	1
<hr/>			
TOTAL	119	75	44

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1915	2	1934	1	1940		
1918	1	1931				
1919	2	1931	1	1934	1	1939
1920	2	1933	2	1934	1	1935
	2	1936	2	1937	1	1939
	2	1940				
1922	1	1931				
1923	1	1931	1	1934	1	1935
	2	1937				
1925	3	1936	1	1938	2	1940
1926	1	1934	1	1936	1	1937
	2	1939	1	1940		
1927	2	1939	2	1940		
1928	1	1939				

6-IN. COMPOUND METERS

Year Installed	Number		
	Installed	In Service	Retired
1912	2	0	2
1914	3	1	2
1917	5	0	5
1919	2	1	1
1920	1	0	1
1922	1	0	1
1923	1	0	1
1924	4	3	1
1925	2	0	2
1926	2	0	2
1927	1	1	0
1929	1	1	0
1930	3	3	0
1931	4	4	0
1932	2	2	0
1933	3	3	0
1936	2	2	0
1937	3	3	0
1938	1	1	0
1940	1	1	0
1941	0	0	0
<hr/>			
TOTAL	44	26	18

Retirements by Years

Year Installed	Number	Year	Number	Year
1912	1	1930	1	1931
1914	1	1931	1	1934
1917	1	1930	4	1931
1919	1	1931		
1920	1	1931		
1922	1	1932		
1923	1	1938		
1924	1	1938		
1925	1	1935	1	1939
1926	1	1932	1	1937

8-IN. COMPOUND METERS

Year Installed	Number		
	Installed	In Service	Retired
1935	1	1	0
1937	1	1	0
1941	0	0	0
<hr/>			
TOTAL	2	2	0

3-IN. TURBINE METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1914	1	1	0
1918	7	0	7
1923	1	1	0
1926	1	1	0
1927	1	1	0
1928	3	3	0
1929	1	1	0
1930	1	1	0
1935	1	1	0
1936	1	1	0
1941	1	1	0
TOTAL	19	12	7

Retirements by Years

<i>Year</i>	<i>Number</i>		<i>Year</i>	
<i>Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>
1918	4	1930	3	1932

4-IN. TURBINE METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1916	1	1	0
1917	4	2	2
1920	2	1	1
1923	1	1	0
1929	1	1	0
1932	1	1	0
1941	0	0	0
TOTAL	10	7	3

4-IN. TURBINE METERS (contd.)

Retirements by Years

<i>Year</i>	<i>Number</i>		<i>Year</i>
<i>Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>
1917	2	1935	
1920	1	1930	

6-IN. TURBINE METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	1	0	1
1917	2	2	0
1923	1	1	0
1924	1	1	0
1925	2	2	0
1926	4	3	1
1928	1	1	0
1929	1	1	0
1941	0	0	0
TOTAL	13	11	2

Retirements by Years

<i>Year</i>	<i>Number</i>		<i>Year</i>
<i>Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>
1912	1	1934	
1926	1	1940	

8-IN. TURBINE METERS

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1917	1	1	0
1941	0	0	0
TOTAL	1	1	0

San Francisco, California

As of December 31, 1940

THE city and county of San Francisco, Calif., are supplied with water through the operations of the Public Utilities Commission. In addition to the San Francisco Water Department, which controls the servicing of water to the customers, as well as certain elements of the supply and transmission works, the commission also has jurisdiction over the Hetch Hetchy Water Supply and Power System, the San Francisco Municipal Railway, the San Francisco Airport and the Department of Street Lighting. This report covers only partially the works under the supervision of the San Francisco Water Department.

The city of San Francisco is located on the southern horn of the Golden Gate, the entrance to the greatest landlocked harbor in the world, at the mouth of the junction of the Sacramento and San Joaquin valleys. In addition to its commerce and shipping establishments, it has a great variety of important manufacturing industries. California has no coal but hydro-electric plants and crude oil furnish plenty of cheap power to run its industries. The great earthquake of 1906 and the fire which raged over a third of the city in its wake destroyed many of San Francisco's links with the past.

More than 30 years of planning and building and an expenditure of some \$100,000,000 were required to bring a water supply from the Hetch Hetchy

Valley in the high Sierras more than 160 mi. away. As of June 30, 1940, the system was furnishing approximately 750,000 persons with water, serving over 120,000 consumers with 68.6 mil.gal. daily.

Development of the Existing System

The first works for supplying water to San Francisco's inhabitants were built in 1858 by a private company, the successors of which subsequently developed supplies south of the city and east of San Francisco Bay. The works were built and operated by private companies until the city purchased the system in 1930 and set up the Municipal Water Department as its operating medium under the Department of Public Works, which in 1932 was succeeded by the present Public Utilities Commission. It was under the city's initiative that the Hetch Hetchy supply was developed and completed for use in 1934.

San Francisco's water supply is obtained from local sources in San Mateo and Alameda counties and from the Tuolumne River watershed in the Sierra Nevada Mountains, known as the Hetch Hetchy development. This system is drawn upon to meet the deficiency in the local supplies and to maintain maximum storage in the local reservoirs. In this development the system east of Alameda Creek is under the control of the Hetch Hetchy Water

Supply organization. From Alameda Creek west the aqueduct and other works are operated by the San Francisco Water Department.

The department's supply facilities are divided for operating purposes into the Peninsula and Alameda Divisions. The Peninsula Division includes all territory south of San Francisco and west of the east shore of the bay. The main units of this division are the Upper and Lower Crystal Springs and San Andres and Pilarcitos reservoirs, together with the pipelines, aqueducts, pumps and other facilities for delivery water into San Francisco and to Peninsula consumers.

The main units of the Alameda Division, which include the parts of the system east of the bay, are the Calaveras Reservoir, Pleasanton wells, infiltration galleries at Sunol and required appurtenances for delivery water to the peninsula and for local consumption.

During the annual period noted the local sources produced 31.4 bil.gal. and the Hetch Hetchy system 14.8 bil.gal., making a total of 46.2 bil.gal.

Basis of Study

The information forming the basis of this study was secured from annual reports and other records of the department. The basic data for the facilities included in this report are substantially complete from the beginning of the system's development.

Mortality Survival Study

Mortality studies were made of large wrought-iron, steel and concrete aqueducts and mains only. The records of cast-iron mains in the distribution sys-

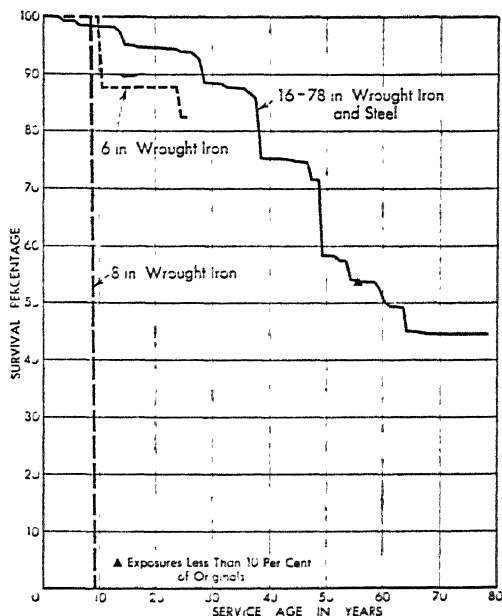


FIG. 1. Mortality Survival Curve—6-78-in. Wrought-Iron and Steel Mains—San Francisco, California

BASE: Feet	SURVIVAL: 1862-1940	
SIZE	EXPOSURES	RETIREMENTS
in.	ft.	ft.
6	4,604	795
8	1,510	1,510
16-78	1,326,451	257,718

tem installed prior to the time of the earthquake and fire in 1906 are incomplete. Table 1 is a summary of the large mains and Fig. 1 represents the corresponding mortality survival curves determined from the study.

There is also included quite a complete summary of those Class B facilities included in wells, infiltration galleries, tunnels and aqueducts, impounding and distribution reservoirs.

Causes of Retirement

The known causes of retirement of the Class B facilities outlined are included in the accompanying summary.

TABLE 1
SUMMARY OF WROUGHT-IRON, STEEL AND CONCRETE MAINS
SAN FRANCISCO, CALIFORNIA

Size, in.	Kind	No. of Feet Installed	Percent- age of Total	No. of Feet Retired	Percent- age of Total	No. of Feet in Service	Percent- age of Total	Year of First Instal- lation	Average Age, yr.
6	Wrought- iron galvanized	208	0.0	0	0	208	0.0	1929	9.4
6	Wrought- iron bitumi- nous- lined and coated	4,396	0.3	795	0.3	3,601	0.3	1915	25.5
8		1,510	0.1	1,510	0.6	0	0	1920	—
12		6,555	0.5	0	0	6,555	0.6	1900	30.1
13		850	0.1	394	0.2	456	0.0	1882	50.5
16		870	0.1	870	0.3	0	0	1895	—
18		4,475	0.3	4,475	1.7	0	0	1887	—
22		63,652	4.7	32,529	12.5	31,123	2.8	1862	53.5
23		6,215	0.5	72	0.0	6,143	0.6	1891	49.5
30		247,468	18.1	122,735	47.2	124,733	11.3	1863	41.2
33		2,409	0.2	0	0	2,409	0.2	1885	55.5
36		149,899	11.0	68,267	26.3	81,632	7.4	1885	49.7
37		14,300	1.0	2,425	0.9	11,875	1.1	1885	51.4
44		133,824	9.8	11,546	4.4	122,278	11.0	1885	52.1
54		17,115	1.2	0	0	17,115	1.5	1891	36.8
10	Steel bitumi- nous- lined and coated	9,580	0.7	0	0	9,580	0.9	1938	2.5
16		40,353	2.9	13,976	5.4	26,377	2.4	1888	14.4
20		65,728	4.8	0	0	65,728	5.9	1926	9.2
22		13,740	1.0	0	0	13,740	1.2	1902	38.3
23½		9,516	0.7	429	0.2	9,087	0.8	1923	17.4
24		26,443	1.9	0	0	26,443	2.4	1926	8.5
28		7,480	0.5	0	0	7,480	0.7	1936	4.5
30		18,561	1.4	0	0	18,561	1.7	1915	10.9
36		69,651	5.1	0	0	69,651	6.3	1924	5.2
44		56,592	4.1	0	0	56,592	5.1	1924	9.1
48		12,354	0.9	0	0	12,354	1.1	1931	9.4
54		73,873	5.4	0	0	73,873	6.7	1928	10.9
60		191,545	14.0	0	0	191,545	17.4	1925	9.8
66		78,896	5.8	0	0	78,896	7.1	1935	5.5
76		3,858	0.3	0	0	3,858	0.3	1935	5.5
78		649	0.0	0	0	649	0.0	1937	3.5
57	Concrete	6,822	0.5	0	0	6,822	0.6	1933	7.5
62		26,014	1.9	0	0	26,014	2.3	1935	5.5
69		3,087	0.2	0	0	3,087	0.3	1934	6.5
TOTAL		1,368,488	100.0	260,023	100.0	1,108,465	100.0		23.1
Percentage of Total		100.00		19.00		81.00			
Average Size, in.		40.1		30.0		42.5			

TABLE 1 (contd.)
Mortality Survival Ratios

Size, in	Kind	No. of Feet	Period Covered, yr.	Percentage
6	Wrought-iron	4,604	25.5	82.323
8		1,510	20.5	0
10 and 12	Wrought-iron and steel	16,135	40.5	100.000
Over 12		1,310,316	78.5	44.415
57-69	Concrete	35,923	7.5	100.000
TOTAL		1,368,488		

Acknowledgment

The collection and compilation of data pertaining to the study in San Francisco were under the general supervision of N. A. Eckart, General

Manager and Chief Engineer of the San Francisco Water Department and a member of the Committee on Survival and Retirement Experience With Water Works Facilities.

SUMMARY OF CLASS B FACILITIES SAN FRANCISCO, CALIFORNIA

Wells

Pleasanton Field

Bored Wells: 10 in. in diameter, wrought-iron cased, 50-196 ft. deep; some artesian, some deep well pumps and some air lift.

Nos. F1, F8, F15, F22—Installed in 1900 and not used because other wells were better.

No. F28—Installed in 1900 and retired in 1930 because other wells were better.

Nos. C1 and C1X—Installed in 1898; no good and not used.

Nos. C2 to C5, C5½, C6 to C14, C16, C19 to C22—Installed in 1898; became standby in 1934 when new supply developed.

Nos. C15, C17, C19½, C22½, C23 to C25, C23½, C24½, C25½—Installed in 1901; became standby in 1934 when new supply developed.

No. C18—Installed in 1898 and retired in 1926 because of collapse.

Nos. C20½, C21½, C27, C28—Installed in 1901 and retired in 1926; no reason given.

Nos. A1, A2, A11, A13, A14, A15, A16, B1—Installed in 1898 and retired in 1909 because of change in collecting system. A14 in use by others in 1926.

Nos. D1, D2, D4, D6, D8, E1 to E7, E10, E16, I2, I6, I4—Installed in 1898 and retired in 1904 because other wells were better.

No. G39—Installed in 1898 and retired prior to 1911; no reason given.

Nos. G7, G10, G29, G37—Installed in 1898 and retired in 1930 because other wells were better.

No. G13—Installed in 1898 and retired in 1924 when replaced with new well.

No. G19—Installed in 1898 and retired in 1926; no reason given.

Nos. G14-M10—Installed in 1900 and retired prior to 1913; no reason given.

No. G1—Installed in 1898 and retired prior to 1926; no reason given.

Nos. H1, H7—Installed in 1898 and retired prior to 1912; no reason given. In use by others after.

No. H25—Installed in 1900 and retired prior to 1911; no reason given.

Nos. M20, M5, L21, M15—Installed in 1900 and retired prior to 1926; no reason given.

Nos. A3 to A7, A9—Installed prior to 1903 and retired about 1909 because of change in collecting system.

Nos. B3, B5—Installed prior to 1904 and retired about 1909 because of change in collecting system.

No. H14—Installed prior to 1904 and retired prior to 1912; no reason given.

Nos. N1, N3, N5, N7, N9, N12, G43, G42, G44, G46, G49, G51—Installed prior to 1904 and retired in 1930 because other wells were better.

No. G40—Installed prior to 1904 and retired in 1926; no reason given.

No. G45—Installed prior to 1904 and retired prior to 1913; no reason given.

Bored Wells: 12 and 10 in. in diameter, wrought-iron cased, 135 to 385 ft. deep; deep well or air lift.

Nos. G35, G36, G41, G33, G14 new, G38½, G34—Installed in 1924 and retired in 1930 because other wells were better.

Nos. M22½, M25—Installed in 1920 and became standby in 1934 when new supply developed.

No. G13 new—Installed in 1924 and became standby in 1934 when new supply developed.

No. M19½—Installed in 1920 and retired prior to 1926; no reason given.

Nos. M33, M36—Installed in 1916 and retired prior to 1926; no reason given.

Nos. C26½, 26½, 27½, 28½—Installed in 1924 and retired prior to 1926; no reason given.

Alameda—Installed in 1919 and retired in 1930 because other wells were better.

Gravel Pack Wells: 14-in. stove pipe casing, 26-in. gravel, 221 to 734 ft. deep; deep well turbines.

Nos. O1, O12, O3, O6, O9, G22, M19½—Installed in 1924; deepened in 1931; became standby in 1934 when new supply developed.

Nos. G38, G6½—Installed in 1931 and became standby in 1934 after new supply developed.

Nos. C21½, F16—Installed in 1926 and became standby in 1934 when new source developed.

No. F19—Same except installed in 1925.

No. F22½—Same except installed in 1924.

Nos. F24½, F27½, G32½, G43½—Same except installed in 1930.

No. G25—Installed in 1924 and retired prior to 1930 because of sanding.

Nos. M10 new, M5 new—Installed in 1924; deepened in 1931 and became standby in 1934 when new supply developed.

No. M15 new—Installed in 1924 and became standby in 1934 when new source developed.

Sunset Field

Gravel Pack Wells: Inner casing 10 to 14 in., outer casing 16 to 20 in., 155 to 270 ft. deep; deep well turbines.

No. 1—Installed in 1931 and retired in 1935 when new source developed.

No. 2—Installed in 1931 and abandoned in 1931 because of freezing.

Nos. 3 and 4 and 21—Installed in 1931 and retired in 1935 when new source developed.

Nos. 5 to 10, and 13 to 20—Installed in 1930 and retired in 1935 when new source developed.

No. 620—Installed in 1915 and retired in 1935 when new source developed.

No. 630—Installed in 1915 and retired in 1930 because of corrosion.

Test 7-in. Drilled Well, 200 ft. deep—Installed in 1931 and retired in 1935.

Leland Avenue No. 1

No details; constructed by realty company prior to 1909 and retired in 1927 because of sanding.

Leland Avenue No. 2

Gravel Pack Well, 16- and 24-in. diameter, 150 ft. deep. Constructed in 1915 and retired in 1933 when cheaper source developed.

Potters Wells

Installed in 1871 and abandoned in 1886. Cost \$10,400. No details available.

Warren and Tuttle Wells

Installed in 1883 and abandoned in 1886. Cost \$10,400. No details available.

Ringold Artesian Wells

Abandoned in 1882. No further details available.

Pilarcitos Artesian Wells

Installed in 1864-65-69 and 1871. All abandoned upon completion; no results.

Lobos Creek Artesian Well

Installed in 1869 and immediately abandoned; no results, and possible lawsuits.

Lobos Creek, Lake Street

Installed in 1901 and abandoned in 1901 because of pollution.

Richmond Nos. 617 and 628

10- to 14-in. drilled wells, 211 and 307 ft. deep; emergency use. Constructed in 1915 and retired in 1924. Cleaned out and pump installed in 1934.

Richmond No. 616

Same, except retired in 1915 because of insufficient yield.

Ravenswood Wells

Total number 49, 7- and 10-in. bored and cased wells; 6 drilled in 1901, rest in 1905. Retired in 1905 because of threatened lawsuits.

Hadsell Field Nos. 1, 2 and 3

12-in. drilled wells 96 to 285 ft. deep; drilled in 1912 and probably never used.

Sunol Valley Wells

Nine or ten shallow wells 15 to 20 ft. deep. Dug in 1901; no details given.

Sunol Valley Concrete Well

Dug well 5 ft. in diameter, 20 ft. deep. Installed in 1901 and retired in 1930; no details given.

Impounding Reservoirs

Upper Pilarcitos—Earth embankment dam across Pilarcitos Creek, 210 ft. long, 36 ft. maximum height; impounding 60 mil.gal.; safe yield 2 mgd. Constructed in 1862 and retired in 1868 because of insufficient capacity, submergence in larger reservoir.

Pilarcitos—Earth embankment dam across Pilarcitos Creek, 520 ft. long, 95 ft. maximum height; impounding 1,000 mil.gal. from natural drainage area of 3.8 sq.mi. and by partial diversion from 1.4 sq.mi. Constructed in 1866, raised 25 ft. in 1874, and still in service.

San Andres—Earth embankment dam across San Andres Creek, 950 ft. long, 105 ft. maximum height; impounding 6,000 mil.gal. from natural drainage area of 4.4 sq.mi. and by partial diversion from 9.2 sq.mi. Safe yield with Pilarcitos of 7 mgd. Constructed in 1870, raised 16 ft. in 1875 and 10 ft. in 1928, and still in service.

Upper Crystal Springs—Earth embankment dam across Laguna Creek, 520 ft. long, 92.5 ft. maximum height, impounding 9,426 mil.gal. from natural drainage area of 9 sq.mi. Constructed in 1877 and retired in 1890 because of insufficient capacity, submergence in larger reservoir. Salvage \$156,000; used as highway.

Lower Crystal Springs—Arched gravity concrete dam across San Mateo Creek, 600 ft. long, 154 ft. maximum height, impounding 22,500 mil.gal. from natural drainage area of 22.5 sq.mi. part diverted to San Andres; safe yield 9 mgd. Constructed in 1888, raised in 1890 and 1911, and still in service.

Calaveras—Earth embankment, part hydraulic fill dam across Calaveras Creek, 1,200 ft. long, 220 ft. maximum height, impounding 31,800 mil.gal. from natural drainage area of 100 sq.mi. and by partial diversion from 35 sq.mi.; safe yield 30 mgd. Constructed in 1925 and still in service.

Infiltration Galleries

Sunol—Concrete, cut and cover, gallery, 3 by 5 ft. to 7 by 10.5 ft., 896 ft. long with 6,050 $1\frac{1}{2}$ - to $1\frac{3}{4}$ -in. inlet pipes with brass strainers. Constructed in 1900 and still in service.

Sunol—Timber, cut and cover, gallery, 8 by 10 ft., 1,180 ft. long. Constructed in 1901 and still in service.

Sunol—Perforated concrete pipe gallery in creek channel, 30-in. diameter, 433 ft. long. Constructed in 1917 and still in service.

Sunol—Perforated concrete pipe gallery in creek channel, 30-in. diameter, 1,300 ft. long. Constructed in 1918 and still in service.

Sunol—Similar gallery, 1,000 ft. long. Constructed in 1926 and still in service.

*Tunnels and Aqueducts**Lobos Creek Aqueduct*

Flume—Lobos Creek to Fort Point—Rectangular covered redwood flume for transmission, 1.6 by 1.9 ft., 12,016 ft. long. Constructed in 1858 and retired in 1893 because of slides and excessive maintenance.

Flume at Fort Point—Rectangular covered redwood flume for transmission, 1.6 by 1.9 ft., 500 ft. long. Constructed in 1858 and retired in 1870 because of slides; replaced by tunnel.

Flume, Fort Point to Black Point—Rectangular covered redwood flume for transmission, 1.6 by 1.9 ft., 12,100 ft. long. Constructed in 1858 and retired in 1862 because of slides and excessive maintenance; replaced by cement pipe and tunnels.

Tunnel—Fort Point—Probably brick-lined tunnel, 3.5 by 3.5 ft., 300 ft. long. Constructed about 1870 and retired in 1870 because of retirement of connecting flumes.

Tunnel—Black Point—Brick-lined tunnel, 2.5 by 4.5 ft., 2,800 ft. long. Constructed in 1862 and retired in 1893 because of retirement of connecting flumes.

Cement Pipe—Cement pipe aqueduct, 2.2 ft. inside diameter, 8,589 ft. long. Constructed in 1862 and retired in 1893 because of retirement of connecting flumes.

Island Creek Aqueduct

Flume—Rectangular covered redwood flume, 1 by 1 ft., 14,000 ft. long. Constructed in 1861 and retired in 1873 because of abandonment of supply.

Original Pilarcitos Aqueduct

Tunnel No. 1—Timber tunnel housing 30-in. pipe, 3.5 by 5.1 ft., 1,495 ft. long. Constructed in 1861, brick lining and pipe removed in 1871; now in present Pilarcitos Aqueduct. Pipe in tunnel riveted sheet iron 2.5-ft. diameter. Installed in 1862; pipe salvaged in 1871.

Flume—Rectangular covered redwood flume, 1.3 by 2.5 ft., 143,000 ft. long. Constructed in 1862 and retired in 1868 because

of insufficient capacity and excessive maintenance.

Pilarcitos Aqueduct

Flume (Sec. 2)—Rectangular covered redwood flume, 2.0 by 3.6 ft., 298 ft. long. Constructed in 1868, rebuilt in 1880 and 1898 and retired in 1941, because of excessive maintenance; replaced with concrete pipe.

Tunnel No. 2 (Sec. 3)—Brick lined, oval shape, 3.5 by 5.1 ft., 3,426 ft. long. Constructed in 1868.

Flume (Sec. 4)—Rectangular covered redwood flume, 1.9 by 3.5 ft., 325 ft. long. Constructed in 1868, replaced in 1897 by pipe because of excessive maintenance.

Pipe (Sec. 4)—44-in. wrought-iron pipe, inverted siphon, 730 ft. long. Installed in 1897.

Flume (Sec. 5)—Rectangular covered redwood flume, 1.9 by 3.5 ft., 2,674 ft. long.

Constructed in 1868, rebuilt in 1902 and replaced with pipe in 1936 because of excessive maintenance.

Pipe (Secs. 6, 8, 10)—22-in. wrought-iron pipe in siphon and outlet, 4,488 ft. long. Constructed in 1887 and retired in 1936 because of deterioration.

Flume (Secs. 7, 9)—Rectangular covered redwood flume, 1.9 by 3.5 ft., 2,310 ft. long. Constructed in 1887, rebuilt in 1904 and replaced with pipe in 1936 because of excessive maintenance.

Pilarcitos Main, Side Flume

Rectangular covered redwood flume, 1.2 by 1.5 to 1.3 by 3.5 ft., 10,000 ft. long. Constructed in 1866, raised in 1867 and 1868, rebuilt in 1877, 5,000 ft. rebuilt in 1910.

Pilarcitos Pipe Line, Flume and Tunnels

Greenhouse Flume—Rectangular covered redwood flume, 3.7 by 3.2 ft., 5,255 ft. long. Constructed in 1868, rebuilt in 1905, 3,000 ft. retired in 1914, 1,455 ft. in 1926.

Lake Honda Tunnel—Brick-lined, oval-shaped tunnel, 3 by 4.3 ft., 2,820 ft. long. Constructed in 1868.

Lakeview Tunnel—Pressure tunnel, 36-in. steel pipe backed with concrete, 784 ft. long. Constructed in 1934.

Bald Hill Tunnel—Brick-lined, oval-shaped tunnel, 3 by 4.7 ft., 2,820 ft. long; reservoir outlet. Constructed in 1870.

North S.A. Outlet Tunnel—Concrete-lined, horseshoe-shaped tunnel, 8 by 8 ft., 718 ft. long; reservoir outlet. Constructed in 1928.

Locks Creek Aqueduct

Flume—Rectangular covered redwood flume, 1 by 1.2 to 1.5 by 2.5 ft., 41,650 ft. long, diversion flume. Constructed in 1871

and retired in 1898 because of slides, accidents, fires, excessive maintenance and small supply.

Pipe—22-in. wrought-iron pipe, 11,902 ft. long, diversion. Constructed in 1871 and retired in 1898 because of abandonment of flume.

Stone Dam Aqueduct

Flumes—Rectangular covered redwood flumes, 2.5 by 5 to 4 by 5 ft., 30,995 ft. long, diversion purpose. Constructed in 1871, 26,715 ft. abandoned in 1898 because of deterioration. New structure relocated and shortened by tunnel.

Tunnel No. 1—Brick-lined, oval-shaped tunnel, 3.5 by 4.5 ft., 3,202 ft. long. Constructed in 1871.

Pipe—37½-in. wrought-iron, 3,718 ft. long. Constructed in 1871 and retired in 1898 when relocated.

Flume—Rectangular covered redwood flumes, 3 by 5 to 4 by 6 ft., 13,808 ft. long. Constructed in 1898, 2,905 ft. replaced in 1937, 10,903 ft. in 1938, 2,905 ft. replaced with concrete pipe.

Tunnel No. 2—Concrete-lined tunnel, 4.3 by 4.3 ft., 3,530 ft. long. Constructed in 1898.

Pipe Siphon—44-in. wrought-iron, 2,109 ft. long. Constructed in 1898 and replaced in 1936.

Pipe Siphon—44-in. steel, 2,106 ft. long. Constructed in 1936.

Concrete Pipe—48-in. diameter, 2,905 ft. long. Constructed in 1937.

Crystal Springs Pump Aqueduct

Flume—Rectangular covered redwood flume, 4 by 5 ft., 29,294 ft. long. Constructed in 1898 and 1903 and replaced with canal in 1932, because of excessive maintenance and limited capacity.

Canal—Gunite-lined canal, 3 to 11 ft. wide, 3.75 ft. deep, 30,200 ft. long. Constructed in 1932, hipped redwood roof added in 1934.

S.A. Tunnel—Concrete-lined tunnel, 5.25 by 6 ft., 412 ft. long. Constructed in 1898.

S.A. Siphon—6-ft. diameter concrete pipe, 603 ft. long. Constructed in 1934.

Outlet No. 1—Brick-lined tunnel, 7.5 by 7.5 ft., 358 ft. long. Constructed in 1891.

Outlet No. 2—Concrete-lined tunnel, 9 by 10 ft., 640 ft. long. Constructed in 1936.

Crystal Springs Pipeline No. 1 Tunnels

Brisbane Tunnel—Circular pressure tunnel, 44-in. wrought-iron pipe, backed with brick, 301 ft. long. Constructed in 1885.

City Tunnel—Brick-lined, horseshoe tunnel, 5.75 by 6.5 ft., 2,144 ft. long. Constructed in 1885.

Sierra Point Tunnel—Concrete-lined horseshoe tunnel, 7 by 7 ft., 400 ft. long. Constructed in 1928 and retired in 1929 because of damage by highway cut below.

Crystal Springs Pipeline No. 2 Tunnels

Tunnel No. 1—Pressure tunnel, 60-in. steel pipe, backed with concrete, 1,427 ft. long. Constructed in 1936.

Tunnel No. 2—Same as No. 1 except 334 ft. long.

Tunnel No. 3—Same as No. 1 except 2,285 ft. long.

Davis Tunnel

Rectangular, concrete-lined, diversion tunnel, 4.33 by 4.75 ft., 1,205 ft. long. Constructed in 1898.

Bernal Tunnels

Two circular pressure tunnels, 44-in. wrought-iron pipes, backed with brick, 225 and 1,120 ft. long; distribution works. Constructed in 1885.

Lake Honda System Tunnels

Upper Outlet Tunnel—60-in. circular outlet tunnel, concrete or brick-lined, 188 ft. long. Constructed in 1897.

Lower Outlet Tunnel—Egg-shaped, concrete-lined distribution tunnel, 4 by 5 ft., 750 ft. long. Constructed in 1864.

7th Avenue Tunnel—Horseshoe-shaped, concrete-lined distribution tunnel, 5.5 by 6 ft., 510 ft. long. Constructed in 1896.

Sewer Tunnel—Oval, concrete-lined drainage tunnel, 5 by 6 ft., 640 ft. long. Constructed in 1901 and retired in 1916 when drainage system changed.

Lake Merced Drainage System

L.M. Tunnel—Oval brick-lined tunnel, 5.5 by 8.5 ft., 3,036 ft. long. Constructed in 1897.

Colma Canal—Brick-lined canal, 10 by 7 ft., 3,840 ft. long. Constructed in 1897.

Drainage Ditch—Earth ditch, unlined, 3 by 3 ft., 2,562 ft. long. Constructed in 1901.

Vista Grande Flume—Rectangular redwood flume, 3 by 3 ft., 6,198 ft. long. Constructed in 1897.

Vista Grande Canal—Brick and concrete-lined canal, 5 by 5 ft., 1,650 ft. long. Constructed in 1897 and retired about 1920.

Abbey Flume—No detail given. Constructed in 1869, rebuilt in 1885 and retired in 1904.

Niles Aqueduct

Masonry Aqueduct—Rubble bottom and walls, arched brick top, 3 by 5 ft., 2,760 ft.

long. Constructed in 1888 and retired in 1930 because of system changes.

Flume—Rectangular covered redwood flume, 4 by 3 ft., 3,200 ft. long. Constructed in 1888, rebuilt in 1904 and retired in 1927 and 1930 because of deterioration and system changes.

Pipe—36-in. wrought-iron pipe, 5,611 ft. long. Constructed in 1888, 312 ft. retired in 1917 and balance about 1937 because of deterioration and system changes.

Pipe—14-in. wrought-iron pipe, 312 ft. long. Constructed in 1917 and retired in 1937 because of system changes.

Concrete Pipe—20-in. concrete, 400 ft. long. Constructed in 1927 and retired in 1930 because of system changes.

Laguna Creek

Ditch—Unlined earth canal, 6 to 20 ft. wide, 6 ft. deep, 1,300 ft. long. Constructed in 1901 and replaced with pipeline in 1909.

Tunnel—Rectangular concrete-lined tunnel, 4.2 ft. by 4.3 ft., 354 ft. long. Constructed in 1901.

Sunol Aqueduct

Tunnels Nos. 1, 3, 4, 5—Rectangular concrete tunnels, 5 by 5.5 ft., 13,707 ft. long. Constructed in 1900.

Tunnel No. 2—(Orig.) same, 394 ft. long. Constructed in 1900 and retired in 1908, in right of way sold to W.P.R.R., replaced at no cost to water company.

Tunnel No. 2 (pres.)—Rectangular concrete tunnel, 6 by 5.67 ft., 856 ft. long. Constructed in 1908.

Flume (4 sect.)—Rectangular covered redwood flumes, 6 by 3.5 ft., 11,922 ft. long. Constructed in 1900 and removed in 1908 and 1923 because of excessive maintenance.

Concrete Aqueduct—Rectangular concrete aqueduct, 5.5 ft. by 5.67 ft., 11,635 ft. long. Constructed in 1923.

Upper Alameda Tunnel

Horseshoe-shaped concrete-lined diversion tunnel, 5.5 by 6.5 ft., 9,709 ft. long. Constructed in 1923.

Calaveras Outlet

Horseshoe-shaped, concrete-lined outlet tunnel, 8 by 8 ft., 1,519 ft. long. Constructed in 1926.

Calaveras Pipeline Tunnel

Similar to above, 1,075 ft. long. Constructed in 1934.

H. H. Irvington Tunnel

Horseshoe-shaped, concrete-lined tunnel, 10.5 ft. by 10.5 ft., 18,192 ft. long. Constructed in 1934.

H. H. Pulgas Tunnel

Horseshoe-shaped, concrete-lined tunnel, 10.25 by 10.25 ft., 9,007 ft. long. Constructed in 1926.

H. H. Pulgas Tunnel Outfall Canal

Reinforced concrete-lined canal, 9 ft. wide, 12 to 3.5 ft. deep, 946 ft. long. Constructed in 1926.

Distribution Reservoirs

Sunset (North Basin)—Cut and fill, concrete-lined and covered basin, 600 by 1,000 ft. maximum area, 29.5 ft. deep, 89.4-mil.gal. capacity. Constructed in 1938 and still in service.

University Mound (South Basin)—Cut and fill, concrete-lined and covered basin, 745 ft. by 765 ft. maximum area, 25.3 ft. deep, 81.5-mil.gal. capacity. Constructed in 1937 and still in service.

University Mound (North Basin)—Cut and fill, concrete-lined open basin, 625 by 780 ft. maximum area, 26.5 ft. deep, 59.4-mil.gal. capacity. Constructed in 1885, raised 6 ft. in 1924 and still in service.

Merced Manor—Cut and fill, concrete-lined and covered basin, 265 by 350 ft. maximum area, 22 ft. deep, 9.5-mil.gal. capacity. Constructed in 1936 and still in service.

Lake Honda—Concrete dam in creek, excavated basin, concrete-lined, open, 320 by 1,265 ft. in area, 35 ft. deep, 44-mil.gal. capacity. Constructed in 1861, raised 6 ft. in 1915 and still in service.

College Hill—Cut and fill, clay and rubble masonry lined, open basin, 360 by 430 ft. in area, 16.5 ft. deep, 13.5-mil.gal. capacity. Constructed in 1870 and still in service.

Francisco Street—Cut and fill, brick-lined, partly covered with wood, 190 by 440 ft. in area, 8 ft. deep, 2.5-mil.gal. capacity. Constructed in 1861, roof added in 1863, rebuilt in 1879 and 1919 and still in service.

Lake Merced—Natural lake increased by two earth dams, open, 2,000 by 15,000 ft. in area, 30 ft. deep, 2,500-mil.gal. capacity. Constructed in 1895, drainage added in 1897-1901 and still in service for emergency storage.

Lombard Street—Cut and fill, brick-lined, open basin, 185 ft. square, 18 ft. deep, 2.7-mil.gal. capacity. Constructed in 1861, roof added in 1862, replaced in 1882, burned off in fire of 1906 and still in service.

Potrero Heights—Circular, rock cut basin, brick- and cement-lined, covered, 120 ft. diameter at top, 22 ft. deep, 1-mil.gal. capac-

ity. Constructed in 1897, wood roof added in 1932 and still in service.

Stanford Heights—Cut and fill, concrete-lined, wood-covered, partitioned basin, about 175 by 525 ft. in area, 20 ft. deep, 11-mil.gal. capacity. West basin constructed in 1923, east basin in 1928 and still in service.

Wilde Avenue—Cut and fill, concrete-lined, wood-covered basin, irregular shaped, 6,150-sq.ft. area, 10 ft. deep, 0.5-mil.gal. capacity. Constructed in 1902, gunited in 1933 and still in service.

Market Street—Basin cut in rock, masonry walls, open, approximately 100 by 200 ft. in area, 15 ft. deep, 2.25-mil.gal. capacity. Constructed in 1862, retired in 1879 because of operating changes, and street cut through.

Brannan Street—Basin cut in rock, brick-lined, open, 80 by 100 ft. in area, 8 ft. deep, 0.4-mil.gal. capacity. Constructed in 1862, retired in 1883 when elevation low and source of supply abandoned.

Original Clay Street—Rectangular, probably redwood basin, no details except 0.1-mil.gal. capacity. Constructed about 1864 and retired about 1874.

Clay Street, 2nd—Redwood basin, about 35 by 60 ft. in area, 9 ft. deep, 0.14-mil.gal. capacity. Constructed in 1874 and retired in 1885 when replaced by larger steel tank.

Clay Street Tank—Circular, wrought-iron, wood-covered tank, 60-ft. diameter, 11 ft. deep, 0.25-mil.gal. capacity. Constructed in 1885, roof burned in 1906 and replaced; still in service.

Clarendon Heights Tank—Circular, wrought-iron, wood-covered tank, 80-ft. diameter, 15 ft. deep, 0.5-mil.gal. capacity. Constructed in 1895 and still in service.

Presidio Heights Tank—Circular, covered steel tank, 60-ft. diameter, 34 ft. deep, 0.7-mil.gal. capacity. Constructed in 1903 and still in service.

Lincoln Park Tank—Circular, covered concrete tank, 26-ft. diameter, 20 ft. deep, 0.08-mil.gal. capacity. Constructed in 1924 and still in service.

Forest Hill Tank—Circular, covered steel tank, 45-ft. diameter, 26 ft. deep, 0.3-mil.gal. capacity. Constructed in 1927 and still in service.

Sunset Tank—Circular, covered concrete tank, 80-ft. diameter, 15 ft. deep, 0.5-mil.gal. capacity. Constructed in 1930, not retired but out of service since Sunset Wells shut down in 1935.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
SAN FRANCISCO, CALIFORNIA

MAINS

6-IN. WROUGHT-IRON GALVANIZED MAINS				
Year	Feet			
Installed	Installed	In Service	Retired	
1929	154	154	0	
1937	54	54	0	
1940	0	0	0	
TOTAL	208	208	0	

6-IN. WROUGHT-IRON BITUMINOUS-LINED AND COATED MAINS				
Year	Feet			
Installed	Installed	In Service	Retired	
1915	4,396	3,601	795	
1940	0	0	0	
TOTAL	4,396	3,601	795	

Retirements by Years				
Year	Feet	Year	Feet	Year
Installed				
1915	564	1925	231	1939

8-IN. WROUGHT-IRON BITUMINOUS-LINED AND COATED MAINS				
Year	Feet			
Installed	Installed	In Service	Retired	
1920	1,510	0	1,510	
1940	0	0	0	
TOTAL	1,510	0	1,510	

Retirements by Years				
Year	Feet	Year		
Installed				
1920	1,510	1929		

12-IN. WROUGHT-IRON BITUMINOUS-LINED AND COATED MAINS				
Year	Feet			
Installed	Installed	In Service	Retired	
1900	1,670	1,670	0	
1914	4,885	4,885	0	
1940	0	0	0	
TOTAL	6,555	6,555	0	

13-IN. WROUGHT-IRON BITUMINOUS-LINED AND COATED MAINS				
Year	Feet			
Installed	Installed	In Service	Retired	
1882	394	0	394	
1890	456	456	0	
1940	0	0	0	
TOTAL	850	456	394	

Retirements by Years				
Year	Feet	Year	Feet	Year
Installed				
1882	38	1906	356	1926

16-IN. WROUGHT-IRON BITUMINOUS-LINED AND COATED MAINS				
Year	Feet			
Installed	Installed	In Service	Retired	
1895	870	0	870	
1940	0	0	0	
TOTAL	870	0	870	

Retirements by Years				
Year	Feet	Year		
Installed				
1895	870	1928		

18-IN. WROUGHT-IRON BITUMINOUS-LINED AND COATED MAINS				
Year	Feet			
Installed	Installed	In Service	Retired	
1887	2,646	0	2,646	
1907	1,829	0	1,829	
1940	0	0	0	
TOTAL	4,475	0	4,475	

Retirements by Years				
Year	Feet	Year		
Installed				
1887	2,646	1898		
1907	1,829	1928		

22-IN. WROUGHT-IRON BITUMINOUS-LINED
AND COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1862	6,600	0	6,600
1863	2,998	0	2,998
1875	13,722	10,134	3,588
1877	16,000	0	16,000
1882	6,828	6,312	516
1884	4,200	4,200	0
1892	2,500	0	2,500
1895	6,991	6,664	327
1913	966	966	0
1914	692	692	0
1919	2,155	2,155	0
1940	0	0	0
TOTAL	63,652	31,123	32,529

Retirements by Years

Year	Feet		Year	Feet		Year	Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1862	6,600	1868						
1863	2,035	1895	963	1926				
1875	422	1906	623	1907	1,903	1935		
	640	1936						
1877	16,000	1891						
1882	516	1908						
1892	2,500	1906						
1895	327	1937						

23-IN. WROUGHT-IRON BITUMINOUS-LINED
AND COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1891	6,215	6,143	72
1940	0	0	0
TOTAL	6,215	6,143	72

Retirements by Years

Year	Feet	Year
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1891	72	1934

30-IN. WROUGHT-IRON BITUMINOUS-LINED
AND COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1863	2,770	0	2,770
1868	67,880	0	67,880
1870	65,700	27,944	37,756

30-IN. WROUGHT-IRON BITUMINOUS-LINED
AND COATED MAINS (contd.)

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	4,513	4,513	0
1891	1,752	1,752	0
1896	9,050	9,050	0
1898	7,516	0	7,516
1907	30,550	28,043	2,507
1909	27,400	27,110	290
1911	13,512	12,196	1,316
1914	3,845	3,845	0
1922	8,052	6,552	1,500
1925	290	290	0
1926	2,729	1,529	1,200
1929	1,909	1,909	0
1940	0	0	0
TOTAL	247,468	124,733	122,735

Retirements by Years

Year	Feet		Year	Feet		Year	Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1863	2,770	1926						
1868	2,500	1892	55,700	1906	9,680	1922		
1870	3,740	1896	25,880	1898	692	1914		
	2,155	1919	3,744	1922	1,305	1929		
	240	1937						
1898	7,516	1911						
1907	407	1926	2,100	1934				
1909	290	1925						
1911	1,000	1935	316	1936				
1922	900	1926	600	1934				
1926	1,200	1934						

33-IN. WROUGHT-IRON BITUMINOUS-LINED
AND COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	2,409	2,409	0
1940	0	0	0
TOTAL	2,409	2,409	0

36-IN. WROUGHT-IRON BITUMINOUS-LINED
AND COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	297	297	0
1888	136,633	73,366	63,267

36-IN. WROUGHT-IRON BITUMINOUS-LINED
AND COATED MAINS (contd.)

Year	Feet		
Installed	Installed	In Service	Retired
1900	5,420	420	5,000
1907	950	950	0
1913	3,194	3,194	0
1926	3,405	3,405	0
1940	0	0	0
TOTAL	149,899	81,632	68,267

Retirements by Years

Year						
Installed	Feet	Year	Feet	Year	Feet	Year
1888	5,283	1924	140	1936	57,844	1938
1900	5,000	1938				

37-IN. WROUGHT-IRON BITUMINOUS-LINED
AND COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1885	11,321	8,896	2,425
1895	1,414	1,414	0
1907	1,565	1,565	0
1940	0	0	0
TOTAL	14,300	11,875	2,425

Retirements by Years

Year		
Installed	Feet	Year
1885	2,425	1912

44-IN. WROUGHT-IRON BITUMINOUS-LINED
AND COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1885	102,439	91,531	10,908
1898	28,895	28,895	0
1901	967	753	214
1907	967	543	424
1916	533	533	0
1931	23	23	0
1940	0	0	0
TOTAL	133,824	122,278	11,546

Retirements by Years

Year						
Installed	Feet	Year	Feet	Year	Feet	Year
1885	8,299	1888	900	1901	1,100	1930
	609	1940				
1901	214	1932				
1907	424	1916				

54-IN. WROUGHT-IRON BITUMINOUS-LINED
AND COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1891	358	358	0
1904	16,757	16,757	0
1940	0	0	0
TOTAL	17,115	17,115	0

10-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1938	9,580	9,580	0
1940	0	0	0
TOTAL	9,580	9,580	0

16-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1923	15,660	14,457	1,203
1926	129	129	0
1928	4,277	4,277	0
1933	6	6	0
1940	0	0	0
TOTAL	20,072	18,869	1,203

Retirements by Years

Year		
Installed	Feet	Year
1923	1,203	1933

20-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1926	7,104	7,104	0
1928	17,925	17,925	0
1929	1,776	1,776	0
1930	10,335	10,335	0
1931	3,800	3,800	0
1935	2,493	2,493	0
1936	22,154	22,154	0
1937	141	141	0
1940	0	0	0
TOTAL	65,728	65,728	0

22-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	140	140	0
1940	0	0	0
TOTAL	140	140	0

23½-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1923	9,136	8,707	429
1926	285	285	0
1927	95	95	0
1940	0	0	0
TOTAL	9,516	9,087	429

Retirements by Years

Year	Feet	Year	Feet	Year
1923	55	1928	374	1929

24-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1926	3,039	3,039	0
1928	9,275	9,275	0
1929	318	318	0
1933	5	5	0
1935	12	12	0
1936	13,794	13,794	0
1940	0	0	0
TOTAL	26,443	26,443	0

28-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1936	7,480	7,480	0
1940	0	0	0
TOTAL	7,480	7,480	0

30-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1915	3,250	3,250	0
1926	4,139	4,139	0
1929	11	11	0
1934	2,890	2,890	0
1935	6,897	6,897	0
1937	642	642	0
1938	63	63	0
1940	669	669	0
TOTAL	18,561	18,561	0

36-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1924	5,200	5,200	0
1926	800	800	0
1930	300	300	0
1931	1,404	1,404	0
1934	4,209	4,209	0
1935	15,408	15,408	0
1936	13,594	13,594	0
1937	710	710	0
1938	28,026	28,026	0
1940	0	0	0
TOTAL	69,651	69,651	0

44-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	883	883	0
1934	34,074	34,074	0
1936	5,568	5,568	0
1940	467	467	0
TOTAL	40,992	40,992	0

48-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1931	11,290	11,290	0
1932	1,064	1,064	0
1940	0	0	0
TOTAL	12,354	12,354	0

54-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1928	57,629	57,629	0
1932	479	479	0
1935	8,849	8,849	0
1938	958	958	0
1940	0	0	0
TOTAL	67,915	67,915	0

60-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1933	250	250	0
1937	79,530	79,530	0
1938	9,981	9,981	0
1940	0	0	0
TOTAL	89,761	89,761	0

66-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1935	78,896	78,896	0
1940	0	0	0
TOTAL	78,896	78,896	0

76-IN. STEEL, BITUMINOUS-LINED AND
COATED AND WRAPPED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1935	3,858	3,858	0
1940	0	0	0
TOTAL	3,858	3,858	0

16-IN. STEEL, BITUMINOUS-LINED AND
COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1936	6,718	6,718	0
1940	0	0	0
TOTAL	6,718	6,718	0

44-IN. STEEL, BITUMINOUS-LINED AND
COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1924	15,600	15,600	0
1940	0	0	0
TOTAL	15,600	15,600	0

60-IN. STEEL, BITUMINOUS-LINED AND
COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1925	101,784	101,784	0
1940	0	0	0
TOTAL	101,784	101,784	0

78-IN. STEEL, BITUMINOUS-LINED AND
COATED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1939	649	649	0
1940	0	0	0
TOTAL	649	649	0

16-IN. GALVANIZED STEEL, BITUMINOUS-
LINED AND COATED (SUBMARINE)
MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1888	13,563	790	12,773
1940	0	0	0
TOTAL	13,563	790	12,773

Retirements by Years

Year	Feet	
Installed	Feet	Year
1888	12,773	1935

22-IN. GALVANIZED STEEL, BITUMINOUS-
LINED AND COATED (SUBMARINE)
MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1902	13,600	13,600	0
1940	0	0	0
TOTAL	13,600	13,600	0

54-IN. STEEL, BITUMINOUS-LINED AND
COATED, CONCRETE-WRAPPED
(SUBMARINE) MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1936	5,958	5,958	0
1940	0	0	0
TOTAL	5,958	5,958	0

57-IN. CONCRETE, STEEL CYLINDER
REINFORCED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1933	6,822	6,822	0
1940	0	0	0
TOTAL	6,822	6,822	0

62-IN. CONCRETE, STEEL CYLINDER
REINFORCED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1935	26,014	26,014	0
1940	0	0	0
TOTAL	26,014	26,014	0

69-IN. CONCRETE, STEEL CYLINDER
REINFORCED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1934	3,087	3,087	0
1940	0	0	0
TOTAL	3,087	3,087	0

Scranton, Pennsylvania

As of December 31, 1940

THE Scranton-Spring Brook Water Service Company, said to be the largest contiguously integrated, privately owned operating water company in the United States, serves 55 municipalities, including the cities of Scranton and Wilkes-Barre, comprising a large part of the northern anthracite coal region of eastern Pennsylvania. The territory included in the service area extends for 70 mi. along both sides of the Susquehanna and Lackawanna rivers from Glen Lyon, located south of Wilkes-Barre, to Forest City, north of Scranton.

The company serves water to 128,917 customers, comprising a population of 650,000 people and, in addition, serves manufactured gas to 29,111 customers in thirteen municipalities. The water property includes 71 storage reservoirs located on mountain streams, which have a combined storage of approximately 20 bil.gal. An average of 84 mil.gal. of water is supplied daily through a transmission and distribution system consisting of 1,284 mi. of all sizes of mains up to 48 in. in diameter.

Development of the Existing System

The Scranton-Spring Brook Water Service Company was formed in 1928 as a subsidiary of the Federal Water Service Company, now the Federal Water and Gas Corporation, by the merger of the Scranton Gas and Wa-

ter Company, which served Scranton and communities to the north, and the Spring Brook Water Supply Company, which served communities, including Wilkes-Barre, south of Scranton.

Each of these companies, in turn, was the result of the merger, consolidation and absorption of 30 to 40 smaller local water companies during a period of nearly 100 years of operation.

For operating convenience the property is divided into two main operating divisions, along the lines of the two predecessor companies, and each division takes its name from the predecessor company.

The Spring Brook Division, serving a 90-sq.mi. area including and surrounding Wilkes-Barre, supplies 355,000 persons who require an average of 50 mgd. This service is supplied from 30 reservoirs storing 11.3 bil.gal. through a system of mains 3 to 48 in. in size, totaling about 754 mi.

The Scranton Division, serving a 75-sq.mi. area including Scranton and sixteen communities north of it, supplies 42,596 customers, or 252,220 people, who require an average of 34 mgd. Service to this division is also from impounding reservoirs, 41 in number, having a total capacity in excess of 8 bil.gal., through 530 mi. of mains, 4 to 48 in. in diameter.

The Scranton Division has been further subdivided for operating purposes into two districts, the Scranton

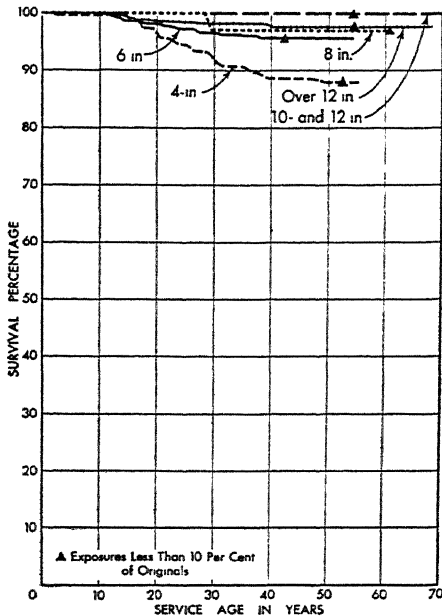


FIG. 1. Mortality Survival Curve—4-48-in. Cast-Iron Unlined Mains—Scranton, Pennsylvania

BASE: Feet	SURVIVAL: 1870-1940	
SIZE	EXPOSURES	RETIREMENTS
in.	ft.	ft.
4	195,704	19,571
6	448,494	14,159
8	47,864	1,160
10 and 12	135,445	55
Over 12	317,440	6,714

Water District, comprising the city of Scranton and Borough of Dunmore, and the Consolidated District, comprising all municipalities north of Scranton. The Scranton Division contains 42,744 services, with 84 per cent of the customers being supplied through 36,201 meters. There are 8,045 valves and 1,858 fire hydrants in service.

The Scranton Water District, with which this report is primarily concerned, serves 26,271 metered customers comprising a population of

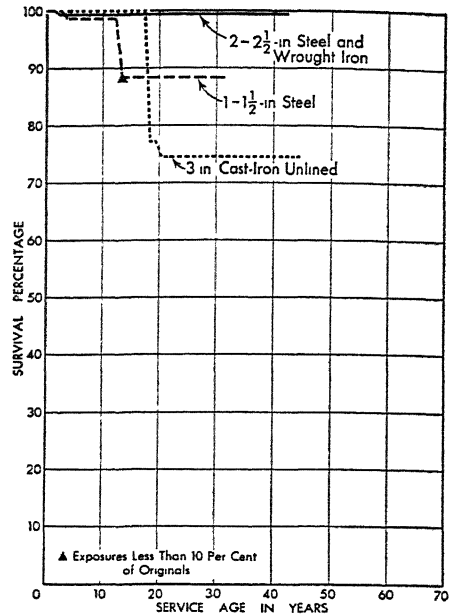


FIG. 2. Mortality Survival Curve—1-3-in. Mains—Scranton, Pennsylvania

BASE: Feet		SURVIVAL: 1896-1940	
SIZE	KIND	EXPO- SURES	RETIRE- MENTS
<i>in.</i>		<i>ft.</i>	<i>ft.</i>
1-1½	Steel	7,709	252
2-2½	Steel and Wrought-Iron	14,087	35
3	Cast-Iron Un- lined	7,679	800.

161,386, requiring 21.3 mgd. of water, supplied through 300.3 mi. of 4- to 48-in. mains. The district contains 27,008 services, 4,936 valves and 1,152 fire hydrants.

Basis of Study

This report is concerned with an analysis of pipe installations and retirements in the Scranton Water District only. The records of such installations and retirements are substantially complete from 1885 to the date of the

TABLE 1
SUMMARY OF MAINS
SCRANTON, PENNSYLVANIA

Size, <i>in.</i>	Kind	No. of Feet Installed	No. of Feet Identified	Per- cent- age of Total	No. of Feet Retired	Per- cent- age of Total	No. of Feet in Service	Per- cent- age of Total	Year of First Instal- lation	Aver- age Age, <i>yr.</i>
2	Cast-iron unlined	115	115	0.0	0	0.0	115	0	1909	31.5
3		31,277	7,679	0.7	800	1.6	6,879	0.6	1896	20.9
4		309,581	195,704	16.6	19,571	38.8	176,133	15.5	1885	40.6
5		1,360	0	0.0	0	0	0	0	—	—
6		734,997	448,494	37.8	14,159	28.1	434,335	38.3	1886	31.0
8		56,320	47,864	4.0	1,160	2.3	46,704	4.1	1880	45.0
10		37,347	36,834	3.1	35	0.1	36,799	3.2	1870	45.5
12		137,161	98,611	8.3	20	0.0	98,591	8.7	1891	32.7
14		8,766	8,766	0.7	968	1.9	7,798	0.7	1884	44.2
16		93,000	92,866	7.8	2,620	5.2	90,246	7.9	1880	41.3
18		51,432	51,432	4.3	1,113	2.2	50,319	4.4	1872	44.0
20		29,859	29,859	2.5	40	0.1	29,819	2.6	1891	37.7
24		48,482	48,482	4.1	1,933	3.8	46,549	4.1	1872	46.9
30		33,919	33,919	2.9	40	0.1	33,879	3.0	1893	42.9
36	46,673	46,673	3.9	0	0.0	46,673	4.1	1893	38.2	
48	5,443	5,443	0.5	0	0.0	5,443	0.5	1897	32.9	
4	Cast-iron cement- lined	126	126	0.0	0	0.0	126	0.0	1935	2.6
6		3,034	3,034	0.3	0	0.0	3,034	0.3	1925	9.2
8		1,044	1,044	0.1	0	0.0	1,044	0.1	1934	3.9
16		98	98	0.0	0	0.0	98	0.0	1933	7.0
1	Steel	2,538	2,538	0.2	222	0.4	2,316	0.2	1927	5.3
1½		926	926	0.1	30	0.1	896	0.1	1920	10.5
1½		3,305	3,305	0.3	0	0.0	3,305	0.3	1909	6.4
2		5,556	5,556	0.5	35	0.1	5,521	0.5	1914	16.2
2½	Gal- vanized steel	22	22	0.0	0	0.0	22	0.0	1928	12.5
3		8	8	0.0	0	0.0	8	0.0	1928	12.5
6		426	426	0.0	0	0.0	426	0.0	1895	4.7
8		255	255	0.0	0	0.0	255	0.0	1893	46.7
10	Steel	125	125	0.0	0	0.0	125	0.0	1928	12.5
1½		360	360	0.0	0	0.0	360	0.0	1936	4.5
2	cement- lined	6,026	6,026	0.5	0	0.0	6,026	0.5	1928	8.1
1		167	167	0.0	0	0.0	167	0.0	1939	1.5
1½		160	160	0.0	0	0.0	160	0.0	1939	1.5
1½		253	253	0.0	0	0.0	253	0.0	1937	3.5
2	Wrought- iron	483	483	0.0	0	0.0	483	0.0	1931	8.2
2		2,000	2,000	0.2	0	0.0	2,000	0.2	1898	40.9
8		120	120	0.0	0	0.0	120	0.0	1912	28.5
10		125	125	0.0	125	0.2	0	0.0	1916	—
16	Kala- mein	110	110	0.0	110	0.2	0	0.0	1897	—
18		3,580	3,580	0.3	3,580	7.1	0	0.0	1872	—
20		3,905	3,905	0.3	3,905	7.7	0	0.0	1872	—
TOTAL		1,660,484	1,187,493	100.0	50,466	100.0	1,137,027	100.0		36.2
Percentage of Total			100.00		4.25		95.75			
Average Size, <i>in.</i>			10.86		8.82		10.95			

TABLE 1 (contd.)
Mortality Survival Ratios

Size, in.	Kind	Number of Feet	Period Covered, yr.	Percentage
2	Cast-iron unlined	115	31.5	100.000
3		7,679	44.5	74.525
4		195,704	55.5	87.927
6		448,494	54.5	95.752
8		47,864	60.5	96.976
10 and 12		135,445	70.5	99.957
Over 12	Cast-iron cement-lined	317,440	68.5	97.628
4-16		4,302	15.5	100.000
1-1½		7,709	31.5	88.521
2 and 2½		14,087	42.5	99.737
3-10		814	47.5	100.000
8-16		355	43.5	—
18 and 20	Kalamein	7,485	40.5	0.000
TOTAL		1,187,493		

study and partially available for an earlier period. Some pipe which was purchased in assembling the system has been included in the study as of the purchase date.

Mortality Survival Study

Mortality studies were made of mains only. Table 1 gives a summary of the pipe installed and that identified as well as the retirements of identified pipe and other pertinent data. Figures 1 and 2 show the mortality survival curves covering the record of the pipe grouped as shown.

Also given is a summary of Class B

facilities of the Scranton Water District.

Causes of Retirement

The record does not give the causes dictating the retirement of pipe. A few retirements have resulted from a cause which could be present in but few cities in the United States, namely, mine subsidence.

Acknowledgment

The collection and compilation of the data in the Scranton plant were under the general supervision of Marc Baum of the Scranton-Spring Brook Water Service Company.

SUMMARY OF CLASS B FACILITIES SCRANTON, PENNSYLVANIA

Impounding Reservoirs

Lake Henry—Formed by damming Lake Henry Creek. Earth embankment dam with masonry core wall, 6 ft. wide on top, 10 ft. maximum height, 1,140 ft. long; capacity 205 mil gal.; drainage area 0.9 sq.mi. Constructed in 1895-96 and still in service.

Lake Scranton—Formed by draining Stafford Meadow Brook. Earth embankment dam with masonry core wall, 12 ft. wide on top, 87 ft. maximum height, 590 ft. long; capacity 2,518 mil gal.; drainage area 6 sq.mi. Constructed in 1893 and still in service.

Gouldsboro Pump Reservoir—Formed by damming Lehigh River. Earth embankment

dam with masonry and steel pile core wall, 12 ft. wide on top, 28 ft. maximum height, 330 ft. long; capacity 80 mil.gal.; drainage area 15.2 sq. mi. Constructed in 1910 and still in service. Present dam replaced stone filled crib dam built in 1895-96.

Dunmore No. 1—Formed by damming Little Roaring Brook. Earth embankment dam with masonry core wall, 8 ft. wide on top, 58 ft. maximum height, 490 ft. long; capacity 75 mil.gal.; drainage area 5.16 sq.mi. Constructed in 1891-92, raised 3.5 ft. in 1900 and 2.5 ft. in 1903; still in service. Present dam replaced earth dam with plank core wall built prior to 1870.

Summit Lake—Formed by damming Summit Lake Creek. Earth embankment with masonry core wall, 10 ft. wide on top, 25 ft. maximum height, 240 ft. long; capacity 259 mil.gal.; drainage area 0.96 sq.mi. Constructed in 1875-76 and still in service.

Maple Lake—Formed by damming Summit Lake Creek. Earth embankment with plastered core wall, 4 ft. wide on top, 22 ft. maximum height, 206 ft. long; capacity 3.7 mil.gal.; drainage area 2.11 sq.mi. Constructed prior to 1890 and still in service.

Dunmore No. 3—Formed by damming Little Roaring Brook. Earth embankment with plank core wall, 10 ft. wide on top, 10 ft. maximum height, 350 ft. long; capacity 18 mil.gal., drainage area 0.13 sq.mi. Constructed in 1851 and still in service.

Dunmore No. 4—Similar to No. 3 except 9 ft. wide on top, 15 ft. maximum height, 600 ft. long; capacity 10 mil.gal.; drainage area 0.25 sq.mi. Constructed in 1851 and still in service.

No. 7—Formed by damming Roaring Brook. Gravity-type masonry dam, 4 ft. wide on top, 45 ft. maximum height, 317 ft. long; capacity 122.5 mil.gal.; drainage area 50 sq.mi. Constructed in 1872; 4 ft. concrete flood wall added in 1902; still in service.

No. 5—Formed by damming Stafford Meadow Brook. Earth embankment with masonry core wall, 3 ft. wide on top, 40 ft. maximum height, 450 ft. long; capacity 32 mil.gal.; drainage area 11.5 sq.mi. Constructed in 1887-90; raised, lengthened and spillway capacity increased; still in service.

Curtis—Formed by damming Oak Run. Earth embankment with masonry core wall, 10 ft. wide on top, 40 ft. maximum height, 377 ft. long; capacity 418 mil.gal.; drainage area 2.4 sq.mi. Constructed in 1887; raised and strengthened; still in service.

Elmhurst—Formed by damming Roaring Brook. Earth embankment with masonry core wall, 8 ft. wide on top, 50 ft. maximum height, 383.5 ft. long; capacity 1,221 mil.gal.; drainage area 37.25 sq.mi. Constructed in 1887-90; raised 3 ft. in 1899, lowered 3 ft. in 1916 and strengthened; still in service.

La Rue—Formed by damming Summit Lake Creek. Gravity masonry dam, 4.5 ft. wide on top, 40 ft. maximum height, 124 ft. long; capacity 0.7 mil.gal., drainage area 2.35 sq.mi. Constructed in 1907 and still in service.

Griffin—Formed by damming Griffin Creek. Earth embankment with masonry core wall, 22 ft. wide on top, 43 ft. maximum height, 429 ft. long; capacity 649 mil.gal.; drainage area 3.21 sq.mi. Constructed in 1887-88 and still in service.

Providence H.S.—Formed by damming Leggetts Creek. Masonry dam and rock fill, 21 ft. wide on top, 17 ft. maximum height, 210 ft. long; capacity 3.7 mil.gal.; drainage area 7.96 sq.mi. Original crib dam constructed prior to 1885; reconstructed in 1901; still in service.

Marshwood—Formed by damming Little Roaring Brook. Earth embankment with masonry core wall, 12 ft. on top, 15 ft. maximum height, 326 ft. long; capacity 48 mil.gal.; drainage area 1.8 sq.mi. Constructed in 1927 and still in service.

Nay Aug—Formed by damming Roaring Brook. Gravity type masonry dam, 5 ft. wide on top, 10 ft. maximum height, 50 ft. long; capacity not determined. Constructed in 1867 and retired in 1872-73 because of pollution of stream by mine drainage, resulting in construction of No. 7 upstream.

Distribution Reservoirs

Madison and Olive—Earth embankment, masonry core wall, concrete lining, uncovered, 100 ft. by 100 ft. in plan, 12 ft. deep; capacity 0.9 mil.gal. Constructed in 1857 and retired in 1893 because of elevation.

No. 6 High-Service—Earth embankment, masonry walls on inside, 165 ft. by 165 ft. in top plan, 18 ft. deep uncovered; capacity 2.63 mil.gal. Constructed in 1891; failed and retired in 1909 due to mine subsidence.

Providence Low-Service—Earth embankment with masonry core wall, uncovered, 73 ft. by 400 ft. in plan, 6 ft. deep; capacity 1.29 mil.gal. Constructed in 1882 and retired in 1911 upon completion of Chinchilla Filter Plant.

Providence Fountain—Earth embankment with masonry core wall uncovered, triangular in plan 20 ft. by 144 ft. by 440 ft., 4 ft. deep; capacity 0.916 mil.gal. Constructed in 1868 and retired in 1911 upon completion of Chinchilla Filter Plant.

Dunmore No. 2—Earth embankment with masonry core wall, uncovered, 130 ft. by 225 ft. in plan, 5.2 ft. deep; capacity 1.15 mil.gal. Constructed in 1900 and abandoned in 1902 due to leakage resulting from mine subsidence.

Tunnels and Aqueducts

Lake Scranton No. 1—Rock tunnel, 7 ft. by 7 ft., 2,871 ft. long, containing 30-in. cast-iron pipeline. Constructed in 1898-99 and still in service.

Lake Scranton No. 2—Rock tunnel, 7 ft. by 9 ft., 4,075 ft. long, containing 48-in. cast-iron pipeline. Constructed in 1907-1908 and still in service.

Wells

Nay Aug No. 1—10-in. drilled well, cased wrought iron 466 ft., uncased 254 ft.; pumped by air lift; capacity 200 gpm. Installed in 1910-11 and still in service.

Nay Aug No. 2—Similar to No. 1 except cased 486 ft., uncased 188 ft. Installed in 1910-11 and still in service.

Nay Aug No. 3—Similar to No. 1 except 452 ft. cased, 28 ft. uncased. Installed in 1910-11 and still in service.

Nay Aug No. 4—Similar to No. 1 except uncased 286 ft. Installed in 1910-11 and still in service.

Nay Aug No. 5—Similar to No. 1 except size is 12-in. and uncased 177 ft. Installed in 1910-11 and still in service.

Nay Aug No. 6—Similar to No. 5 except cased 616 ft., uncased 404 ft. Installed in 1910-11 and still in service.

Nay Aug No. 7—Similar to No. 6. Installed in 1910-11 and still in service.

NOTE: These wells are used as auxiliary supplies.

Purification Plant

Chinchilla Filter Plant—Gravity, concrete, rapid sand filter plant; 6-mgd. nominal capacity. Constructed in 1909-10 and still in service. Used during periods of emergency only.

Pumping Equipment

No. 6 Pumping Station—Horizontal compound steam pump, rated 2-mgd. capacity at 150-ft. head; 75 hp. Delivered water from No. 7 pipeline to No. 6 High-Service Reservoir. Installed in 1891-92 and retired in 1908 due to completion of parallel line from Williamsburg Bridge supply, which eliminated its need.

Lehigh Pumping Station—Horizontal compound steam pump, rated 10-mgd. capacity at 21-ft. head; two 150-hp. boilers; operated during extreme dry periods to deliver water from Lehigh River to Roaring Brook headwaters. Installed in 1895 and still in service.

Nay Aug Pumping Station—One single cylinder, steam-driven air compressor, 381-cfm. capacity; and one two-cylinder steam-driven air compressor, 1,650-cfm. capacity, with six 60-hp. steam boilers. Used for pumping by air Nay Aug wells. Installed in 1910-11; compressors still in service; one boiler retired in 1914 and five in 1918. Salvage value \$4,250; original cost \$6,000.

Two two-cylinder, pelton, water-wheel-driven air compressors, 1,650- and 1,965-cfm. capacity. Installed in 1910-11 and still in service.

Carbon Street Pumping Station—Steam driven displacement pump, details not known. Used for delivering water from Lackawanna River to distribution system. Installed in 1857 and retired 1867 due to mine drainage pollution of Lackawanna River.

Elevated Standpipes

Chinchilla Standpipe—Covered steel standpipe, 26.5-ft. diameter, 36 ft. high; capacity 150,000 gal. Erected in 1909 and still in service during operation of filter plant.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
SCRANTON, PENNSYLVANIA

MAINS

2-IN. CAST-IRON UNLINED MAINS*

Year	Feet		
Installed	Installed	In Service	Retired
1909	115	115	0
1940	0	0	0
TOTAL	115	115	0

* 13,244 ft. of 2-in. cast-iron pipe in Dunmore system, installed prior to 1900, was retired from 1901 to 1940.

3-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1896	395	295	100
1897	700	0	700
1901	937	937	0
1908	19	19	0
1909	30	30	0
1910	117	117	0
1912	30	30	0
1913	128	128	0
1915	40	40	0

3-IN. CAST-IRON UNLINED MAINS (contd.)

Year	Feet		
Installed	Installed	In Service	Retired
1916	160	160	0
1917	45	45	0
1920	485	485	0
1921	65	65	0
1923	400	400	0
1924	335	335	0
1925	1,118	1,118	0
1926	1,710	1,710	0
1927	965	965	0
1940	0	0	0

SUBTOTAL	7,679	6,879	800
Unknown	23,598	4,555	19,043

TOTAL	31,277	11,434	19,843
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Retirements by Years

Year	Feet	
Installed	Year	
1896	100	1916
1897	700	1915

4-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1885	6,089	3,989	2,100
1886	2,620	2,620	0
1887	10,552	10,420	132
1888	1,150	930	220
1889	8,710	8,148	562
1890	3,901	3,411	490
1891	7,559	5,597	1,962
1892	14,399	11,935	2,464
1893	10,685	9,704	981
1894	4,691	4,621	70
1895	10,936	9,583	1,353
1896	16,247	14,262	1,985
1897	11,411	10,517	894
1898	10,580	8,662	1,918
1899	12,636	11,571	1,065
1900	3,980	3,750	230
1901	5,930	5,900	30
1902	10,425	8,200	2,225
1903	8,450	8,370	80

Year	Feet		
Installed	Installed	In Service	Retired
1904	1,421	1,021	400
1905	1,403	1,403	0
1906	620	470	150
1907	972	972	0
1908	676	676	0
1909	334	334	0
1910	677	677	0
1911	205	205	0
1912	981	981	0
1913	1,047	1,047	0
1914	368	368	0
1915	265	265	0
1916	545	545	0
1917	470	210	260
1918	105	105	0
1919	2,945	2,945	0
1920	530	530	0
1921	610	610	0
1922	720	720	0

SURVIVAL AND RETIREMENT

4-IN. CAST-IRON UNLINED MAINS (contd.)

Year				Feet			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1923	1,075	1,075	0	1934	144	144	0
1924	3,030	3,030	0	1939	3	3	0
1925	2,913	2,913	0	1940	60	60	0
1926	2,165	2,165	0				
1927	5,985	5,985	0	SUBTOTAL	195,704	176,133	19,571
1928	1,881	1,881	0	Unknown	113,877	83,175	30,702
1929	1,834	1,834	0				
1930	634	634	0	TOTAL	309,581	259,308	50,273
1931	135	135	0				

Retirements by Years

Year								Year							
Installed	Feet	Year	Feet	Year	Feet	Year		Installed	Feet	Year	Feet	Year	Feet	Year	
1885	2,100	1915							220	1918	190	1924	115	1940	
1887	132	1934						1898	323	1900	250	1915	20	1923	
1888	220	1926							1,325	1924					
1889	162	1900	400	1912				1899	655	1915	410	1922			
1890	490	1924						1900	230	1921					
1891	930	1911	828	1927	204	1940		1901	30	1921					
1892	840	1915	150	1919	235	1927		1902	160	1918	1,750	1919	50	1923	
	685	1930	554	1931					220	1927	45	1936			
1893	981	1924						1903	70	1912	10	1925			
1894	70	1920						1904	400	1919					
1895	230	1912	1,123	1924				1906	150	1919					
1896	60	1914	1,850	1916	75	1921		1917	30	1919	230	1929			
1897	100	1913	209	1914	60	1916									

5-IN. CAST-IRON UNLINED MAINS

Year				Feet			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
Unknown	1,360	1,110	250				
TOTAL	1,360	1,110	250				

6-IN. CAST-IRON UNLINED MAINS

Year				Feet			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1886	1,490	1,490	0				
1887	8,920	8,920	0				
1888	650	0	650				
1889	6,571	6,571	0				
1890	432	432	0				
1891	3,298	3,298	0				
1893	469	469	0				
1895	1,969	1,969	0				
1896	6,788	5,520	1,268				
1897	7,439	6,249	1,190				
1898	7,396	7,346	50				
1899	21,574	20,864	710				
1900	34,499	33,474	1,025				

6-IN. CAST-IRON UNLINED MAINS (contd.)

Year				Feet			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1901	16,181	15,395	786				
1902	20,445	19,610	835				
1903	17,951	17,361	590				
1904	18,953	17,320	1,633				
1905	15,372	13,797	1,575				
1906	9,086	8,536	550				
1907	12,098	12,098	0				
1908	16,809	15,527	1,282				
1909	20,660	20,360	300				
1910	13,668	13,423	245				
1911	13,160	13,160	0				
1912	18,166	18,166	0				
1913	16,348	15,088	1,260				
1914	9,470	9,470	0				
1915	12,565	12,565	0				
1916	8,065	8,065	0				
1917	6,980	6,930	50				
1918	2,195	2,035	160				
1919	5,335	5,335	0				
1920	3,825	3,825	0				
1921	10,300	10,300	0				

6-IN. CAST-IRON UNLINED MAINS (contd.)

Year Installed	Feet			Retirements by Years							
	Installed	In Service	Retired	Year Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1922	10,545	10,545	0	1888	650	1926					
1923	9,060	9,060	0	1896	1,060	1927	208	1931			
1924	12,995	12,995	0	1897	740	1918	250	1920	200	1921	
1925	15,070	15,070	0	1898	50	1925					
1926	6,735	6,735	0	1899	710	1926					
1927	11,890	11,890	0	1900	200	1917	35	1922	658	1927	
1928	2,144	2,144	0		132	1930					
1929	2,372	2,372	0	1901	500	1915	250	1916	36	1938	
1930	381	381	0	1902	480	1923	325	1924	30	1925	
1931	443	443	0	1903	400	1922	190	1924			
1932	633	633	0	1904	650	1916	191	1917	90	1919	
1933	288	288	0		702	1927					
1934	605	605	0	1905	1,000	1919	575	1923			
1935	294	294	0	1906	550	1919					
1936	3,394	3,394	0	1908	50	1917	310	1918	350	1919	
1938	139	139	0		500	1926	72	1930			
1939	830	830	0	1909	300	1912					
1940	1,549	1,549	0	1910	160	1924	85	1936			
SUBTOTAL	448,494	434,335	14,159	1913	55	1926	1,145	1927	60	1935	
Unknown	286,503	271,496	15,007	1917	50	1919					
TOTAL	734,997	705,831	29,166	1918	160	1921					

8-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet			Year Installed	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1880	1,080	1,080	0	1918	220	220	0
1881	6,240	6,240	0	1919	570	570	0
1884	8,400	8,400	0	1920	30	30	0
1887	2,880	2,880	0	1921	815	815	0
1889	2,879	2,879	0	1922	840	840	0
1890	566	566	0	1923	20	20	0
1891	1,585	425	1,160	1927	140	140	0
1892	816	816	0	1930	510	510	0
1893	4,737	4,737	0	1931	1,098	1,098	0
1894	1,565	1,565	0	1933	297	297	0
1895	16	16	0	1938	7	7	0
1896	1,560	1,560	0	1940	0	0	0
1900	1,630	1,630	0	SUBTOTAL	47,864	46,704	1,160
1901	320	320	0	Unknown	8,456	3,406	5,050
1902	230	230	0	TOTAL	56,320	50,110	6,210
1905	3,546	3,546	0				
1907	300	300	0	Retirements by Years			
1909	5	5	0	Year			
1912	1,181	1,181	0	Installed	Feet	Year	
1913	2,551	2,551	0	1891	1,160	1920	
1914	700	700	0				
1915	530	530	0				

SURVIVAL AND RETIREMENT

10-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1870	2,160	2,160	0	1912	3,759	3,724	35
1879	2,304	2,304	0	1915	110	110	0
1880	1,500	1,500	0	1916	3,395	3,395	0
1881	264	264	0	1919	285	285	0
1882	180	180	0	1924	20	20	0
1883	1,800	1,800	0	1925	21	21	0
1884	24	24	0	1933	626	626	0
1886	192	192	0	1934	46	46	0
1887	6,816	6,816	0	1940	0	0	0
1890	600	600	0				
1891	1,507	1,507	0	SUBTOTAL	36,834	36,799	35
1892	2,640	2,640	0	Unknown	513	513	0
1893	2,280	2,280	0				
1895	1,812	1,812	0	TOTAL	37,347	37,312	35
1902	190	190	0				
1903	1,449	1,449	0				
1907	25	25	0				
1908	2,745	2,745	0				
1909	40	40	0				
1910	44	44	0				

<i>Retirements by Years</i>			
<i>Year</i>	<i>Feet</i>	<i>Year</i>	
1912	35	1926	

12-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1891	2,800	2,800	0	1919	1,430	1,430	0
1893	2,357	2,357	0	1920	315	315	0
1895	3,912	3,912	0	1923	5,010	5,010	0
1897	8,512	8,512	0	1924	6,700	6,700	0
1898	2,800	2,800	0	1925	687	687	0
1899	16,128	16,128	0	1926	3,010	3,010	0
1902	1,003	1,003	0	1927	4,130	4,130	0
1903	7,958	7,958	0	1934	11	11	0
1904	2,491	2,491	0	1938	17	17	0
1905	6,038	6,018	20	1940	0	0	0
1907	1,457	1,457	0				
1908	376	376	0	SUBTOTAL	98,611	98,591	20
1909	5,621	5,621	0	Unknown	38,550	36,005	2,545
1910	60	60	0				
1911	1,305	1,305	0	TOTAL	137,161	134,596	2,565
1912	250	250	0				
1913	3,081	3,081	0				
1914	402	402	0				
1915	6,890	6,890	0				
1916	345	345	0				
1917	3,290	3,290	0				
1918	225	225	0				

<i>Retirements by Years</i>			
<i>Year</i>	<i>Feet</i>	<i>Year</i>	
1905	20	1921	

14-IN. CAST-IRON UNLINED MAINS

Feet				Retirements by Years		
Year	Installed	In Service	Retired	Year	Feet	Year
Installed				Installed		
1884	568	0	568	1884	568	1893
1892*	3,000	2,600	400	1892	400	1919
1893	2,520	2,520	0			
1903	1,498	1,498	0			
1904	1,180	1,180	0			
1940	0	0	0			
TOTAL	8,766	7,798	968			

16-IN. CAST-IRON UNLINED MAINS

Feet				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
Installed				Installed			
1880	13,365	13,365	0	1915	2,165	2,165	0
1883	72	72	0	1916	3,160	3,160	0
1885*	2,328	2,328	0	1920	770	770	0
1886	1,460	1,460	0	1921	2,545	2,545	0
1887	790	540	250	1922	400	400	0
1888*	5,016	5,016	0	1923	465	465	0
1889*	718	718	0	1924	2,805	2,805	0
1890*	684	684	0	1925	1,590	1,590	0
1891	2,730	2,730	0	1926	215	215	0
1892	5,150	5,150	0	1932	12	12	0
1893	10,740	9,745	995	1940	0	0	0
1894*	36	36	0				
1895	6,725	5,350	1,375	SUBTOTAL	92,866	90,246	2,620
1897	3,648	3,648	0	Unknown	134	134	0
1899	367	367	0				
1903	3,004	3,004	0	TOTAL	93,000	90,380	2,620
1904	3,245	3,245	0				
1907	980	980	0				
1908	1,168	1,168	0				
1909	3,392	3,392	0				
1910	5,079	5,079	0				
1911	885	885	0				
1913	3,587	3,587	0				
1914	3,570	3,570	0				

Retirements by Years

Year	Feet	Year	Feet	Year
Installed		Installed		
1887	250	1926		
1893	435	1916	560	1920
1895	1,375	1911		

* Year purchased.

18-IN. CAST-IRON UNLINED MAINS

Feet				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
Installed				Installed			
1872	763	0	763	1907	40	40	0
1873	85	85	0	1908	1,560	1,560	0
1889	13,985	13,985	0	1914	4,966	4,966	0
1890	6,290	6,290	0	1925	300	300	0
1892	192	192	0	1926	2,110	2,110	0
1893	11,425	11,425	0	1927	25	25	0
1894	3,240	3,240	0	1934	3	3	0
1895	132	132	0	1940	0	0	0
1899	187	187	0				
1903	4,195	4,195	0				
1904	1,934	1,584	350	TOTAL	51,432	50,319	1,113

18-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Retirements by Years</i>			
<i>Year</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1872	763	1912	
1904	350	1923	

20-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1891	360	360	0
1892	820	780	40
1893	8,200	8,200	0
1896*	240	240	0
1898*	504	504	0
1903	953	953	0
1904	3,168	3,168	0
1905	883	883	0
1908	11,344	11,344	0
1911	615	615	0
1913	2,752	2,752	0
1922	20	20	0
1940	0	0	0
TOTAL	29,859	29,819	40

Retirements by Years

<i>Year</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1892	40	1919	

* Year purchased.

24-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1872	9,135	9,135	0
1887	5,100	5,100	0
1888	4,820	4,820	0
1889	2,000	2,000	0
1892	1,056	1,056	0
1893	2,767	2,767	0
1895	8,714	6,781	1,933
1898	660	660	0
1903	589	589	0
1904	1,078	1,078	0
1908	198	198	0
1909	3,000	3,000	0
1914	9,325	9,325	0
1916	40	40	0
1940	0	0	0
TOTAL	48,482	46,549	1,933

24-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Retirements by Years</i>			
<i>Year</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1895	1,933	1909	

30-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	4,738	4,738	0
1894	570	570	0
1899	27,196	27,196	0
1903	495	495	0
1908	20	20	0
1910	865	825	40
1926	35	35	0
1940	0	0	0
TOTAL	33,919	33,879	40

Retirements by Years

<i>Year</i>			
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	
1910	40	1917	

36-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1893	7,446	7,446	0
1898	15,176	15,176	0
1907	5,760	5,760	0
1908	16,958	16,958	0
1909	1,333	1,333	0
1940	0	0	0
TOTAL	46,673	46,673	0

48-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1897	213	213	0
1908	5,230	5,230	0
1940	0	0	0
TOTAL	5,443	5,443	0

4-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1935	52	52	0
1940	74	74	0
TOTAL	126	126	0

6-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	595	595	0
1926	710	710	0
1927	490	490	0
1934	216	216	0
1940	1,023	1,023	0
TOTAL	3,034	3,034	0

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1934	597	597	0
1940	447	447	0
TOTAL	1,044	1,044	0

16-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1933	53	53	0
1934	45	45	0
1940	0	0	0
TOTAL	98	98	0

1-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	895	673	222
1933	100	100	0
1934	28	28	0
1939	1,515	1,515	0
1940	0	0	0
TOTAL	2,538	2,316	222

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1927	222	1940

1½-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1920	355	355	0
1925	60	30	30
1929	30	30	0
1934	123	123	0
1939	358	358	0
1940	0	0	0
TOTAL	926	896	30

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1925	30	1928

1½-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1909	86	86	0
1920	65	65	0
1925	185	185	0
1927	425	425	0
1928	22	22	0
1929	60	60	0
1932	162	162	0
1934	108	108	0
1937	1,121	1,121	0
1939	849	849	0
1940	222	222	0
TOTAL	3,305	3,305	0

2-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1914	235	235	0
1919	500	500	0
1920	135	135	0
1922	2,160	2,125	35
1923	340	340	0
1925	25	25	0
1926	10	10	0
1927	350	350	0
1928	856	856	0
1929	90	90	0
1930	130	130	0
1931	283	283	0
1932	44	44	0
1933	211	211	0
1934	187	187	0
1940	0	0	0
TOTAL	5,556	5,521	35

2½-IN. STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1928	22	22	0
1940	0	0	0
TOTAL	22	22	0

3-IN. STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1928	8	8	0
1940	0	0	0
TOTAL	8	8	0

6-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1895	40	40	0
1940	386	386	0
TOTAL	426	426	0

8-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1893	203	203	0
1897	52	52	0
1940	0	0	0
TOTAL	255	255	0

10-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1928	125	125	0
1940	0	0	0
TOTAL	125	125	0

1½-IN. STEEL CEMENT-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1936	360	360	0
1940	0	0	0
TOTAL	360	360	0

2-IN. STEEL CEMENT-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1928	496	496	0
1929	1,888	1,888	0
1930	437	437	0
1931	234	234	0
1932	505	505	0
1933	449	449	0
1934	141	141	0
1936	961	961	0
1938	195	195	0
1939	237	237	0
1940	483	483	0
TOTAL	6,026	6,026	0

1-IN. STEEL LEAD-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1939	167	167	0
1940	0	0	0
TOTAL	167	167	0

1¼-IN. STEEL LEAD-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1939	160	160	0
1940	0	0	0
TOTAL	160	160	0

1½-IN. STEEL LEAD-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1937	253	253	0
1940	0	0	0
TOTAL	253	253	0

2-IN. STEEL LEAD-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1931	403	403	0
1939	80	80	0
1940	0	0	0
TOTAL	483	483	0

2-IN. WROUGHT-IRON MAINS*

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1898	1,750	1,750	0
1911	250	250	0
1940	0	0	0
TOTAL	2,000	2,000	0

* 220 ft. of 2-in. wrought-iron pipe retired in 1916; date of installation unknown.

8-IN. WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	120	120	0
1940	0	0	0
TOTAL	120	120	0

10-IN. WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1916	125	0	125
1940	0	0	0
TOTAL	125	0	125

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1916	125	1928

16-IN. WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1897	110	0	110
1940	0	0	0
TOTAL	110	0	110

Retirements by Years

Year	Feet	Year	Feet	Year
<i>Installed</i>				
1897	65	1933	45	1934

18-IN. KALAMEIN MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1872	3,580	0	3,580
1940	0	0	0
TOTAL	3,580	0	3,580

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1872	3,850	1911

20-IN. KALAMEIN MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1872	3,905	0	3,905
1940	0	0	0
TOTAL	3,905	0	3,905

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1872	3,905	1912

Springfield, Massachusetts

As of December 31, 1942

THE water supply of the city of Springfield, Mass., is provided by municipally owned works under the control of the Board of Water Commissioners. In addition to the city of Springfield, the municipal water works supplies West Wilbraham, Agawam, East Longmeadow, Longmeadow, Southwick, Mundale, Ludlow, Wilbraham and, in emergencies, West Springfield.

Springfield, located on the east bank of the Connecticut River, just east of the Berkshires in the western part of the state, is a distributing center with important diversified industries. Among the varied products made here are firearms, brass goods, foundry and machine shop products, confectionery, paper goods, automobile and radio parts and accessories, machinery, cotton and knit goods, leather goods, tools, mattresses and bed springs.

At the time of the study the estimated population of the city proper and its environs served by the system was about 190,000. Active service connections numbered 25,212, over 99 per cent of which were metered. The total amount of water furnished to the system during 1942 was 7.9 bil.gal. or a daily rate of 21.7 mil.gal. Approximately 87 per cent of the water was accounted for on customers' meters.

Development of the Existing System

The first developed supply in Springfield was a small private supply secured

from springs in 1843. It was diverted to a reservoir and thence served through about 3 mi. of 4- to 7-in. log pipes. In 1848 a charter was granted to the Springfield Aqueduct Company, which immediately started the construction of several reservoirs and some 11 mi. of distribution pipe. In 1860, the City Aqueduct commenced operation under contract with the city but ceased operation in 1861 upon objection to its well supplies. In 1864 the original wood pipes of the Springfield Aqueduct Company were replaced with the cement pipe, invented by Jonathan Ball and made by Goodhue & Birnie of Springfield, which were prevalently being installed in many New England cities at that time. At the same time the original reservoir, Lombard Reservoir, was enlarged and the East and West Van Horn reservoirs constructed.

In 1872 the city consummated the purchase of the Springfield Aqueduct Company and commenced the operation of the works in 1873. In the three following years the Ludlow supply works were constructed. The present main supply works at Westfield Little River were started in 1907, the purification works were expanded in 1924 and the Cobble Mountain development was constructed in 1927-30.

The present supply is secured from surface supplies at two points, the main system at Westfield Little River, located in the Berkshires about 15 mi. west of the city, and the Ludlow sup-

TABLE 1
SUMMARY OF MAINS
SPRINGFIELD, MASSACHUSETTS

Size, in.	Kind	No of Feet Installed	Percent- age of Total	No of Feet Retired	Percent- age of Total	No. of Feet in Service	Percent- age of Total	Year of First Instal- lation	Average Age, yr.
4	Cast-iron unlined	81,909	3.5	39,710	8.3	42,199	2.3	1870	36.8
6		527,998	22.8	45,728	9.6	482,270	26.2	1866	41.9
8		699,662	30.1	20,209	4.3	679,453	36.8	1866	22.3
10		88,893	3.8	2,629	0.6	86,264	4.7	1873	23.6
12		104,052	4.5	5,686	1.2	98,366	5.3	1865	34.2
16		84,232	3.6	3,587	0.8	80,645	4.4	1865	30.7
20		7,913	0.4	10	0.0	7,903	0.4	1890	35.5
24		44,945	1.9	602	0.1	44,343	2.4	1874	28.3
30		51,832	2.2	1,669	0.4	50,163	2.7	1874	45.2
36		31,048	1.3	199	0.0	30,849	1.7	1894	40.2
42		2,254	0.1	75	0.0	2,179	0.1	1909	33.5
$\frac{3}{4}$	Wrought- iron and steel	1,069	0.0	1,069	0.2	0	0	1871	—
1		24,469	1.1	14,797	3.1	9,672	0.5	1873	17.0
$1\frac{1}{4}$		56,897	2.5	30,792	6.5	26,105	1.4	1870	14.7
$1\frac{1}{2}$		32,007	1.4	16,797	3.5	15,210	0.8	1883	15.5
2		107,078	4.6	59,396	12.5	47,682	2.6	1875	17.3
$2\frac{1}{2}$		159	0.0	0	0	159	0.0	1939	3.5
3		2,016	0.1	2,016	0.4	0	0	1877	—
10	Steel	28	0.0	0	0	28	0.0	1931	11.5
16		253	0.0	0	0	253	0.0	1929	12.1
18		13,144	0.6	0	0	13,144	0.7	1940	2.5
20		443	0.0	0	0	443	0.0	1926	5.3
24		71	0.0	0	0	71	0.0	1915	26.1
30		2,163	0.1	0	0	2,163	0.1	1909	33.5
36		3,822	0.2	0	0	3,822	0.2	1910	15.1
42		61,930	2.7	17	0	61,913	3.4	1909	33.3
48		18,309	0.8	0	0	18,309	1.0	1929	13.5
51		13	0	0	0	13	0	1929	13.5
54		16,155	0.7	0	0	16,155	0.9	1929	13.5
60		71	0.0	0	0	71	0.0	1932	10.5
66		279	0.0	0	0	279	0.0	1929	13.5
72		23	0.0	0	0	23	0.0	1929	13.5
$\frac{3}{4}$	Copper	60	0.0	0	0	60	0.0	1940	2.5
1		254	0.0	0	0	254	0.0	1940	2.2
$1\frac{1}{4}$		291	0.0	0	0	291	0.0	1941	1.5
$1\frac{1}{2}$	Brass	2	0.0	0	0	2	0.0	1941	1.5
2	Brass and Copper	578	0.0	0	0	578	0.0	1940	2.5

TABLE 1 (contd.)

Size, in.	Kind	No of Feet Installed	Percent- age of Total	No. of Feet Retired	Percent- age of Total	No of Feet in Service	Percent- age of Total	Year of First Instal- lation	Average Age, yr.
2	Cement	1,610	0.1	1,610	0.3	0	0	1865	—
3		51,765	2.2	51,765	10.9	0	0	1865	—
4		19,464	0.8	19,464	4.1	0	0	1865	—
6		53,737	2.3	53,737	11.3	0	0	1865	—
8		31,459	1.4	31,459	6.5	0	0	1864	—
10		2,485	0.1	2,485	0.5	0	0	1866	—
12		17,081	0.7	17,081	3.6	0	0	1864	—
16		16,206	0.7	16,206	3.4	0	0	1874	—
20		4,365	0.2	4,365	0.9	0	0	1874	—
24	52,789	2.3	33,329	7.0	19,460	1.1	1874	68.5	
8	Asbestos- cement	3,127	0.1	0	0	3,127	0.2	1942	0.5
10		1,232	0.1	0	0	1,232	0.1	1936	6.5
TOTAL		2,321,642	100.0	476,489	100.0	1,845,153	100.0		29.6
Percentage of Total		100.00		20.5		79.5			
Average Size, in.		10.5		6.8		11.5			

Mortality Survival Ratios

Size, in.	Kind	No. of Feet	Period Covered, yr.	Percentage
4	Cast-iron unlined	81,909	72.5	13.015
6		527,998	68.5	89.786
8		699,662	67.5	92.090
10 and 12		192,945	69.5	86.827
Over 12		222,224	68.5	96.422
$\frac{1}{2}$ -1 $\frac{1}{2}$	Steel and wrought-iron	114,442	51.5	8.059
2-3		109,253	59.5	0
2-4	Cement	72,839	43.5	0
6-10		87,681	45.5	0
12-20		37,652	40.5	0
24		52,789	68.5	36.863
10-72	Steel	116,704	33.5	99.973
$\frac{1}{2}$ -2	Copper and brass	1,185	2.5	100.000
8 and 10	Asbestos-cement	4,359	6.5	100.000
TOTAL		2,321,642		

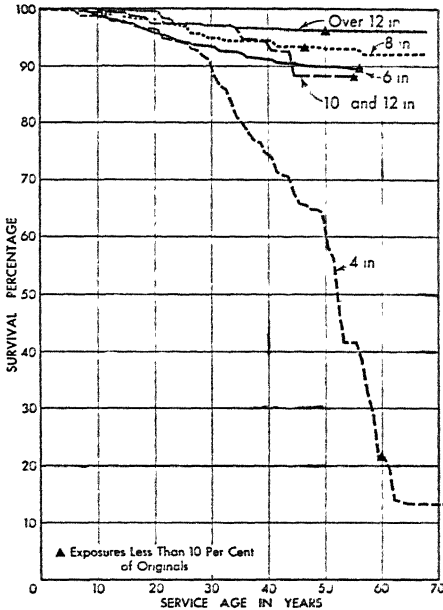


FIG. 1. Mortality Survival Curve—4-42-in. Cast-Iron Unlined Mains—Springfield, Massachusetts

BASE: Feet		SURVIVAL: 1865-1942	
SIZE	EXPOSURES	RETIREMENTS	
in.	ft.	ft.	
4	81,909	39,710	
6	527,998	45,728	
8	699,662	20,209	
10 and 12	192,945	8,315	
Over 12	222,224	6,142	

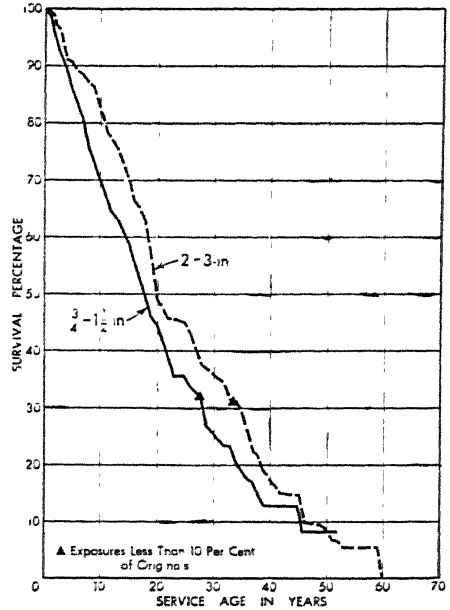


FIG. 2. Mortality Survival Curve—1-3-in. Wrought-Iron and Steel Mains—Springfield, Massachusetts

BASE: Feet		SURVIVAL: 1870-1942	
SIZE	EXPOSURES	RETIREMENTS	
in.	ft.	ft.	
$1-1\frac{1}{2}$	114,442	63,455	
2-3	109,253	61,412	

ply, located in the towns of Ludlow and Belchertown northeast of the city. The latter works supply the town of Ludlow and a part of Wilbraham and are normally valved off from the main system at the Chicopee River.

The Westfield Little River system has a drainage area of 48.5 sq.mi., providing, with its storage, a safe yield of 55 mgd. Borden Brook reservoir, built in 1908-09, has an impounding capacity of 2.5 bil.gal. The supply from this reservoir flows through the natural stream bed to Cobble Mountain

Reservoir. This reservoir, built in 1928-30 across Little River, is formed by a hydraulic-fill dam impounding 22.8 bil.gal. A 10-ft. tunnel extends 8,000 ft. to penstocks, which descend to a power house on the bank of Little River and to a small reservoir which diverts the water, after purification, to the city about 13 mi. away. The purification works include sedimentation basin, aerator and covered slow sand filters having an aggregate capacity of from 24 to 30 mgd.

The filtered supply is conveyed to distribution reservoirs at Provin Mountain through a 42-in. steel pipeline about 40,000 ft. long. The Provin

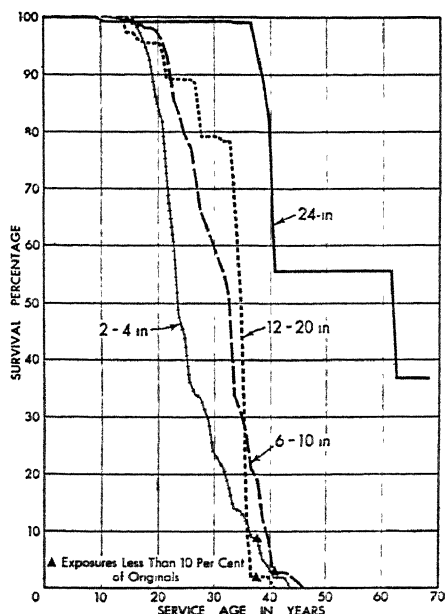


FIG. 3. Mortality Survival Curve—2-24-in. Cement Mains—Springfield, Massachusetts

BASE: Feet	SURVIVAL: 1864-1942	
SIZE	EXPOSURES	RETIREMENTS
in.	ft.	ft.
2-4	72,839	72,839
6-10	87,681	87,681
12-20	37,652	37,652
24	52,789	33,329

Mountain reservoirs are concrete covered basins; one built in 1909 holds 17 mil.gal. and the second built in 1932 holds 12.3 mil.gal. Two pipelines, over diverging routes, convey the supply to the city. The first line, built in 1909, extends 22,170 ft. as 42-in. steel to the Connecticut River, continuing as two 30-in. steel pipes across the river and thence as 42-in. cast-iron pipe to the distribution system. The second line is welded steel, laid in 1929, and extends 16,100 ft. as 54-in. and 16,665 ft. as 48-in., crossing the Connecticut River as two lines of 36-in. pipe 1,700 ft. long laid in the river bed.

The Ludlow supply is a surface supply from watersheds aggregating 20.5 sq.mi. It is secured largely by diversion into the Ludlow distributing reservoir. The safe yield is about 11 mgd. Ludlow Reservoir has a storage capacity of about 1.4 bil.gal. Four 3-mgd open slow sand filters purify the water before service. Two mains extend from the reservoir to the Chicopee River. One line, originally laid in 1874, is of 24-in. diameter, cement-lined and -coated wrought-iron, 19,460 ft. long, with a section of cast-iron pipe 4,805 ft. long. The second line, consisting of 13,388 ft. of 36-in. pipe and 14,217 ft. of 30-in. pipe, was laid in 1894.

The distribution mains within the city system comprise 355 mi. of $\frac{3}{4}$ - to 72-in. pipe, predominately cast iron. There are 25,212 active services, 25,081 of which are metered. They are of varying standard kinds and sizes of pipe and are paid for by the consumers. The system has 9,673 valves, 3,061 public fire hydrants and 25,845 meters.

Basis of Study

The records of installation and retirement of pipe are accurately reflected in annual reports from 1864 to the present date. The basis of this study is a similar study of the mortality of the pipe system in Springfield carried forward by the Supervising Co-ordinator of the Committee on Survival and Retirement, in collaboration with Reeves Newsom, and reported in papers before the Association and published in the October 1939 and May 1940 JOURNALS. This study has been brought up to the date of this report.

Mortality Survival Study

Mortality studies of distribution and transmission mains without classifica-

tion only were made. Table 1 is a summary of the pipe installed, the amount retired and that still in service, as well as other pertinent data. Figures 1, 2 and 3 show the mortality survival curves covering the records of the amount and sizes of pipe grouped as shown.

Causes of Retirement

The causes of retirement of mains were not determined.

Acknowledgment

The collection and compilation of data relative to the installation and re-

tirement of mains in Springfield were carried out by the Supervising Coordinator in the first instance before the formation of the Committee on Survival and Retirement Experience With Water Works Facilities and reported to the Association as previously stated. These studies were continued to bring them to the date of this report. The city of Springfield Municipal Water Works, through Leland G. Carlton, Superintendent, member of the above Committee, co-operated in furnishing the original records from which the data were secured.

SUMMARY OF INSTALLATIONS AND RETIREMENTS SPRINGFIELD, MASSACHUSETTS

MAINS

4-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1870	173	173	0	1904	20	0	20
1873	433	0	433	1905	108	36	72
1874	292	0	292	1906	8	8	0
1875	65	0	65	1907	180	38	142
1876	5,703	886	4,817	1909	1,625	1,237	388
1877	4,464	1,263	3,201	1910	3,175	3,161	14
1878	5,464	3	5,461	1911	2,389	2,389	0
1879	6,276	1,384	4,892	1912	1,638	1,638	0
1880	1,895	222	1,673	1913	3,833	3,681	152
1881	1,980	0	1,980	1914	3,769	3,769	0
1882	1,595	0	1,595	1915	2,500	2,500	0
1883	2,286	399	1,887	1916	781	781	0
1884	1,589	0	1,589	1917	576	576	0
1885	998	353	645	1919	135	135	0
1886	471	117	354	1920	299	296	3
1887	1,225	971	254	1921	128	128	0
1888	1,046	404	642	1922	12	12	0
1889	762	130	632	1923	457	282	175
1890	2,610	1,955	655	1924	492	492	0
1891	1,595	1,203	392	1925	150	150	0
1892	508	204	304	1928	551	551	0
1893	2,290	607	1,683	1929	497	497	0
1894	696	190	506	1932	512	500	12
1895	1,331	248	1,083	1933	278	278	0
1896	1,309	212	1,097	1935	10	10	0
1897	1,297	1,246	51	1936	240	231	9
1898	264	253	11	1939	386	386	0
1899	1,393	1,095	298	1941	14	14	0
1900	3,259	3,259	0	1942	1,044	1,044	0
1901	629	12	617				
1903	2,204	590	1,614				
				TOTAL	81,909	42,199	39,710

Retirements by Years

Year						Year							
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1873	51	1885	80	1889	242	1910	1878	64	1911	18	1912	69	1913
	60	1911						9	1914	1,113	1917	107	1930
1874	52	1908	240	1909				338	1931	654	1934	1,450	1935
1875	12	1895	53	1910				982	1940				
1876	1,360	1906	42	1908	24	1910	1879	17	1888	24	1895	24	1902
	131	1911	72	1913	52	1914		399	1905	338	1908	599	1923
	483	1917	510	1921	2,086	1935		2,562	1931	394	1935	535	1940
	57	1940					1880	513	1908	54	1910	584	1911
1877	36	1885	362	1903	34	1910		210	1921	312	1939		
	80	1911	9	1912	25	1913	1881	15	1908	450	1917	562	1931
	59	1914	676	1927	1,065	1935		945	1934	8	1939		
	792	1939	63	1940			1882	508	1888	524	1935	563	1939
1878	211	1906	416	1909	30	1910	1883	712	1933	338	1934	837	1935

4-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year				Year				Year				Year			
Installed	Feet	Year	Feet	Year	Feet	Year	Feet	Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1884	455	1896	52	1907	186	1913		1896	13	1912	5	1914	1,079	1930	
	366	1931	511	1934	19	1935		1897	4	1905	6	1908		4	1933
1885	16	1904	579	1906	50	1934			37	1935					
1886	126	1907	228	1939				1898	11	1920					
1887	124	1907	13	1908	117	1910		1899	9	1909	10	1918	279	1939	
1888	83	1908	163	1910	29	1912		1901	15	1907	15	1913	587	1938	
	77	1931	290	1940				1903	23	1909	62	1928	1,529	1936	
1889	20	1898	95	1909	272	1910		1904	20	1938					
	14	1911	6	1918	225	1939		1905	72	1923					
1890	4	1898	52	1908	9	1909		1907	142	1914					
	2	1934	10	1935	3	1937		1909	14	1910	148	1919		77	1935
	114	1939	461	1941					149	1939					
1891	228	1908	88	1923	76	1931		1910	14	1931					
1892	304	1908						1913	42	1927	17	1936		93	1937
1893	31	1895	12	1905	19	1906		1920	3	1928					
	32	1920	514	1923	665	1934		1923	143	1930	32	1935			
	410	1935						1932	12	1935					
1894	506	1939						1936	9	1936					
1895	197	1910	169	1931	717	1939									

6-IN. CAST-IRON UNLINED MAINS

Year				Year			
Feet				Feet			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1866	170	0	170	1902	7,304	7,271	33
1870	155	0	155	1903	11,615	10,946	669
1871	1,117	0	1,117	1904	9,365	8,267	1,098
1875	1,938	1,231	707	1905	13,440	11,071	2,369
1876	2,456	1,640	816	1906	12,568	11,532	1,036
1877	2,136	2,092	44	1907	11,480	10,540	940
1879	850	0	850	1908	12,714	12,522	192
1880	600	0	600	1909	14,338	13,271	1,067
1881	7,041	6,947	94	1910	14,305	13,343	962
1882	90	90	0	1911	21,351	20,520	831
1883	3,304	2,647	657	1912	17,889	17,569	320
1884	9,299	8,083	1,216	1913	12,855	12,619	236
1885	5,167	4,504	663	1914	4,469	4,454	15
1886	12,501	10,972	1,529	1915	4,198	4,198	0
1887	20,510	17,696	2,814	1916	3,771	3,696	75
1888	17,940	16,697	1,243	1917	2,444	2,384	60
1889	20,060	18,865	1,195	1918	2,144	2,144	0
1890	17,038	14,091	2,947	1919	961	831	130
1891	17,500	16,479	1,021	1920	960	960	0
1892	21,620	19,948	1,672	1921	1,213	1,213	0
1893	18,786	14,840	3,946	1922	1,174	1,174	0
1894	15,483	15,418	65	1923	483	483	0
1895	18,184	16,237	1,947	1924	1,938	1,801	137
1896	14,966	14,228	738	1925	1,568	1,568	0
1897	35,501	32,396	3,105	1926	537	537	0
1898	27,706	23,062	4,644	1927	1,444	1,444	0
1899	14,154	13,605	549	1928	1,482	1,482	0
1900	7,159	6,587	572	1929	926	926	0
1901	6,036	5,567	469	1930	1,823	1,823	0

SURVIVAL AND RETIREMENT

6-IN. CAST-IRON UNLINED MAINS (contd.)

Feet				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1931	160	160	0	1938	2,922	2,922	0
1932	2,011	2,011	0	1939	2,620	2,616	4
1933	113	113	0	1940	1,045	1,045	0
1934	3,337	3,328	9	1941	884	884	0
1935	559	559	0	1942	771	771	0
1936	784	784	0				
1937	2,566	2,566	0	TOTAL	527,998	482,270	45,728

Retirements by Years

Feet				Feet			
Year	Installed	Year	Feet	Year	Installed	Year	Feet
1866	170	1890		1895	38	1905	75
1870	155	1903			178	1912	70
1871	1,117	1893			492	1926	188
1875	60	1905	549	1896	322	1909	68
1876	1	1908	815		51	1915	292
1877	44	1910		1897	67	1908	1,401
1879	850	1915			88	1912	530
1880	600	1911			29	1931	234
1881	26	1910	24	1898	51	1905	1,217
	14	1913			485	1912	1,731
1883	447	1909	135		764	1927	240
1884	20	1890	171	1899	6	1903	12
	370	1910	14		23	1911	23
	175	1921	116	1900	28	1912	15
1885	48	1889	16		3	1916	228
	44	1908	284		96	1922	
	72	1911	10	1901	101	1909	2
	42	1918	60		64	1938	
1886	1,127	1909	57	1902	33	1912	
	11	1928	15	1903	322	1911	21
1887	548	1907	678		110	1934	86
	294	1910	870	1904	253	1909	259
	66	1922			280	1933	
1888	7	1890	42	1905	32	1907	24
	46	1910	38		647	1914	1,253
1889	7	1890	25		250	1929	20
	49	1911	713	1906	338	1911	24
	237	1925	16		115	1938	103
1890	11	1891	10	1907	27	1913	10
	37	1908	1,452		246	1928	391
	743	1911	25		180	1942	
	167	1941		1908	192	1914	
1891	255	1908	45	1909	15	1913	3
	455	1913			555	1928	396
1892	54	1908	184	1910	19	1911	87
	176	1911	189		10	1915	
	551	1937	77	1911	189	1913	22
1893	10	1907	101		23	1919	418
	1,566	1914	44		3	1929	11
	1,555	1934	510	1912	33	1914	12
1894	12	1908	12	1913	124	1919	112
	24	1914		1914	15	1931	
1895	49	1900	50	1916	75	1927	

6-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year				Year			
Installed	Feet	Year	Feet	Installed	Feet	Year	Feet
1917	60	1927		1934	9	1934	
1919	130	1927		1939	4	1941	
1924	137	1941					

8-IN. CAST-IRON UNLINED MAINS

Year				Year			
Installed	Feet	In Service	Retired	Installed	Feet	In Service	Retired
1866	115	0	115	1910	5,207	5,207	0
1871	36	0	36	1911	7,024	6,252	772
1873	1,505	0	1,505	1912	11,636	11,589	47
1875	8,144	7,489	655	1913	22,572	22,514	58
1876	8,029	6,782	1,247	1914	21,740	21,677	63
1877	230	0	230	1915	29,473	29,443	30
1880	3,402	3,402	0	1916	17,428	17,381	47
1881	2,428	1,963	465	1917	12,357	12,357	0
1882	4,359	4,139	220	1918	2,121	2,121	0
1883	2,158	300	1,858	1919	14,144	14,144	0
1884	1,624	1,615	9	1920	16,532	16,529	3
1885	1,612	510	1,102	1921	18,871	18,834	37
1886	3,652	3,264	388	1922	16,615	16,615	0
1887	4,817	4,471	346	1923	21,954	21,954	0
1888	5,747	4,360	1,387	1924	33,818	33,650	168
1889	2,568	1,347	1,221	1925	35,911	35,647	264
1890	2,029	1,882	147	1926	29,192	29,183	9
1891	4,328	4,222	106	1927	12,105	12,057	48
1892	2,771	2,214	557	1928	12,287	12,287	0
1893	4,041	2,413	1,628	1929	32,734	32,734	0
1894	2,548	2,036	512	1930	14,755	14,755	0
1895	7,310	7,071	239	1931	14,185	14,173	12
1896	9,341	9,228	113	1932	13,044	13,044	0
1897	6,224	5,057	1,167	1933	9,944	9,911	33
1898	3,810	3,810	0	1934	7,849	7,849	0
1899	3,095	3,095	0	1935	9,598	9,598	0
1900	2,457	2,457	0	1936	3,211	3,211	0
1901	2,931	1,075	1,856	1937	10,016	10,016	0
1902	2,480	2,480	0	1938	13,041	13,041	0
1903	2,875	2,630	245	1939	25,881	25,881	0
1904	698	698	0	1940	26,925	26,925	0
1905	9,448	9,009	439	1941	24,594	24,594	0
1906	4,956	4,607	349	1942	8,401	8,401	0
1907	5,685	5,350	335				
1908	11,429	11,340	89	TOTAL	699,662	679,453	20,209
1909	5,615	5,563	52				

Retirements by Years

Year				Year			
Installed	Feet	Year	Feet	Installed	Feet	Year	Feet
1866	115	1915		1876	56	1902	410
1871	36	1896		1877	230	1909	11
1873	280	1893	1,225	1881	465	1910	
1875	28	1888	15	1882	125	1909	58
	21	1913	136	1883	1,858	1896	37
1876	700	1893	50	1884	9	1909	

8-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year						Year					
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year
1885	716	1907	28	1910	325	1913	1906	328	1910	21	1914
	33	1915					1907	10	1908	12	1910
1886	388	1908					1908	15	1913	64	1938
1887	16	1908	19	1910	311	1914	1909	12	1910	40	1914
1888	19	1908	1,316	1909	52	1914	1911	40	1912	378	1913
1889	1,221	1915					1912	26	1913	9	1915
1890	3	1908	9	1909	135	1913	1913	14	1936	44	1939
1891	21	1901	20	1908	21	1910	1914	12	1915	36	1928
	28	1918	16	1930			1915	30	1936		
1892	541	1908	16	1910			1916	47	1926		
1893	1,441	1896	24	1914	163	1927	1920	3	1927		
1894	31	1900	6	1901	475	1915	1921	37	1937		
1895	85	1900	87	1911	67	1939	1924	168	1930		
1896	93	1908	20	1918			1925	190	1926	74	1941
1897	404	1908	23	1923	47	1936	1926	9	1937		
	7	1937	686	1938			1927	48	1942		
1901	76	1907	1,780	1909			1931	12	1933		
1903	227	1908	18	1915			1933	33	1933		
1905	180	1913	67	1931	192	1933					

10-IN. CAST-IRON UNLINED MAINS

Year				Year			
Feet				Feet			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1873	1,004	1,004	0	1921	3,835	3,835	0
1874	3,211	1,638	1,573	1922	3,937	3,937	0
1875	416	416	0	1923	1,399	1,399	0
1879	31	31	0	1924	3,647	3,647	0
1880	559	538	21	1925	1,585	1,585	0
1886	12	12	0	1926	1,307	1,307	0
1900	1,135	1,135	0	1927	421	421	0
1905	752	0	752	1928	2,325	2,325	0
1906	1,430	1,430	0	1929	630	630	0
1907	496	496	0	1930	1,264	1,264	0
1908	14,012	14,006	6	1931	321	321	0
1910	5,119	4,870	249	1932	3,021	3,021	0
1911	653	653	0	1933	610	610	0
1912	438	428	10	1934	5,590	5,590	0
1913	4,642	4,642	0	1936	644	644	0
1914	4,060	4,060	0	1938	65	65	0
1915	3,352	3,334	18	1939	704	704	0
1916	1,845	1,845	0	1941	549	549	0
1917	1,165	1,165	0	1942	8,505	8,505	0
1918	2,544	2,544	0				
1919	264	264	0				
1920	1,394	1,394	0				
				TOTAL	88,893	86,264	2,629

Retirements by Years

Year					Year				
Installed	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year
1874	28	1891	1,545	1918	1910	249	1929		
1880	21	1918			1912	10	1914		
1905	752	1913			1915	8	1918	10	1936
1908	6	1914							

12-IN. CAST-IRON UNLINED MAINS

Feet				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1865	200	0	200	1914	4,825	4,825	0
1873	240	84	156	1915	595	595	0
1875	3,766	2,710	1,056	1917	2,734	2,734	0
1883	2,688	2,688	0	1919	1,412	1,412	0
1884	735	735	0	1920	106	106	0
1885	4,589	4,589	0	1921	2,049	2,049	0
1886	3,608	3,608	0	1922	1,879	1,879	0
1888	2,868	2,654	214	1923	1,224	1,224	0
1889	1,853	1,169	684	1924	3,427	3,427	0
1890	4,235	2,800	1,435	1925	2,266	2,266	0
1892	1,192	1,192	0	1926	698	698	0
1893	1,312	1,051	261	1927	1,829	1,829	0
1894	900	900	0	1928	958	958	0
1895	6,164	6,164	0	1930	2,321	2,321	0
1896	55	49	6	1931	250	250	0
1897	28	0	28	1932	1,844	1,844	0
1900	884	884	0	1933	1,895	1,895	0
1902	950	950	0	1934	1,658	1,658	0
1906	1,287	1,287	0	1937	280	280	0
1907	2,018	1,855	163	1938	513	513	0
1908	5,106	5,106	0	1939	621	621	0
1909	236	229	7	1940	103	103	0
1910	2,043	2,043	0	1941	229	229	0
1911	2,175	2,175	0	1942	0	0	0
1912	678	678	0				
1913	20,526	19,050	1,476	TOTAL	104,052	98,366	5,686

Retirements by Years

Year				Year			
Installed	Feet	Year	Feet	Installed	Feet	Year	Feet
1865	200	1909		1893	261	1927	
1873	156	1907		1896	6	1909	
1875	25	1908	930	1897	28	1909	
1888	214	1913		1907	163	1921	
1889	15	1908	9	1909	7	1914	
1890	15	1908	1,420	1913	722	1928	239
						1929	515
						1930	

16-IN. CAST-IRON UNLINED MAINS

Feet				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1865	200	0	200	1906	2,224	2,224	0
1874	1,956	1,956	0	1908	2,447	2,447	0
1875	3,918	3,600	318	1909	1,636	1,636	0
1882	1,205	1,205	0	1910	1,765	1,765	0
1884	1,589	1,589	0	1911	3,369	3,369	0
1885	1,515	1,515	0	1912	2,547	2,547	0
1889	3,371	3,371	0	1913	66	66	0
1890	318	318	0	1914	16,436	16,392	44
1896	3,202	3,202	0	1915	763	763	0
1897	5	0	5	1917	829	829	0
1899	2,755	0	2,755	1918	1,244	1,244	0
1900	265	0	265	1920	8,337	8,337	0

16-IN. CAST-IRON UNLINED MAINS (contd.)

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1921	5,151	5,151	0
1922	3,708	3,708	0
1924	234	234	0
1926	3,177	3,177	0
1929	23	23	0
1931	102	102	0
1932	207	207	0
1933	3,181	3,181	0
1935	1,519	1,519	0
1937	3,016	3,016	0
1938	686	686	0
1940	8	8	0
1941	1,008	1,008	0
1942	250	250	0
TOTAL	84,232	80,645	3,587

Retirements by Years

Year	Feet	Year	Feet	Year
<i>Installed</i>				
1865	200	1909		
1875	318	1909		
1897	5	1909		
1899	8	1913	2,747	1920
1900	265	1909		
1914	44	1937		

20-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1890	10	0	10
1894	1,672	1,672	0
1908	1,778	1,778	0
1911	2,324	2,324	0
1912	2,129	2,129	0
1942	0	0	0
TOTAL	7,913	7,903	10

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1890	10	1909

24-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1874	3,736	3,390	346
1885	215	80	135
1893	350	350	0
1894	1,980	1,980	0
1907	40	40	0
1910	11,442	11,442	0

24-IN. CAST-IRON UNLINED MAINS (contd.)

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1911	490	490	0
1912	2,540	2,419	121
1913	3,752	3,752	0
1914	8,245	8,245	0
1915	835	835	0
1936	11,149	11,149	0
1937	171	171	0
1942	0	0	0
TOTAL	44,945	44,343	602

Retirements by Years

Year	Feet	Year	Feet	Year
<i>Installed</i>				
1874	346	1894		
1885	135	1914		
1912	9	1936	112	1937

30-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1874	120	120	0
1893	9,846	9,785	61
1894	30,053	28,475	1,578
1899	300	270	30
1907	7,284	7,284	0
1909	100	100	0
1910	2,345	2,345	0
1917	1,784	1,784	0
1942	0	0	0
TOTAL	51,832	50,163	1,669

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1893	61	1915
1894	1,578	1917
1899	30	1940

36-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1894	13,388	13,388	0
1907	2,563	2,563	0
1908	4,167	4,167	0
1909	8,017	7,818	199
1910	2,864	2,864	0
1932	10	10	0
1938	39	39	0
1942	0	0	0
TOTAL	31,048	30,849	199

36-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Retirements by Years</i>				
<i>Year</i>				
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1909	39	1909	160	1914

42-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1909	2,254	2,179	75
1942	0	0	0
TOTAL	2,254	2,179	75

Retirements by Years

<i>Year</i>		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1909	75	1931

¾-IN. WROUGHT-IRON AND STEEL MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1871	180	0	180
1917	160	0	160
1921	19	0	19
1922	435	0	435
1924	195	0	195
1926	80	0	80
1940	0	0	0
TOTAL	1,069	0	1,069

Retirements by Years

<i>Year</i>		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1871	180	1898
1917	160	1940
1921	19	1923
1922	435	1928
1924	195	1936
1926	80	1929

1-IN. WROUGHT-IRON AND STEEL MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1873	260	0	260
1876	300	0	300
1881	447	0	447
1882	571	0	571
1885	255	0	255
1887	88	0	88
1888	234	0	234
1889	48	0	48
1892	211	0	211
1896	100	0	100

1-IN. WROUGHT-IRON AND STEEL MAINS (contd.)

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1897	136	75	61
1898	335	250	85
1900	88	20	68
1902	147	56	91
1904	9	0	9
1905	22	0	22
1906	557	0	557
1907	33	0	33
1908	399	0	399
1910	121	0	121
1911	38	0	38
1912	954	98	856
1913	1,277	0	1,277
1914	661	192	469
1915	662	235	427
1916	505	0	505
1917	326	75	251
1918	488	161	327
1919	107	0	107
1920	997	470	527
1921	710	162	548
1922	2,341	944	1,397
1923	1,882	1,237	645
1924	2,903	902	2,001
1925	2,065	1,262	803
1926	908	711	197
1928	589	391	198
1929	193	193	0
1932	122	42	80
1933	253	253	0
1934	357	326	31
1936	371	347	24
1937	144	144	0
1938	129	0	129
1940	322	322	0
1942	804	804	0
TOTAL	24,469	9,672	14,797

Retirements by Years

<i>Year</i>						
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1873	260	1902				
1876	100	1888	200	1895		
1881	447	1892				
1882	250	1894	220	1903	101	1917
1885	255	1886				
1887	88	1908				
1888	234	1897				
1889	24	1908	17	1915	7	1916
1892	211	1899				
1896	51	1899	10	1904	39	1905
1897	42	1905	4	1912	15	1913

1-IN. WROUGHT-IRON AND STEEL MAINS
(contd.)

Retirements by Years (contd.)

Year	Installed	Feet	Year	Feet	Year	Feet	Year
1898	24	1917	61	1932			
1900	68	1906					
1902	70	1909	21	1936			
1904	9	1908					
1905	22	1911					
1906	557	1921					
1907	33	1913					
1908	40	1909	100	1910	259	1915	
1910	121	1914					
1911	38	1925					
1912	218	1913	146	1915	24	1917	
	380	1921	88	1931			
1913	102	1913	191	1914	136	1916	
	138	1919	18	1920	40	1921	
	76	1922	210	1923	308	1924	
	58	1931					
1914	40	1914	30	1915	60	1919	
1914	134	1921	104	1925	101	1927	
1915	4	1915	31	1916	69	1917	
	24	1922	240	1926	28	1928	
	30	1929	1	1932			
1916	13	1917	10	1920	482	1921	
1917	18	1922	208	1925	25	1937	
1918	63	1919	264	1925			
1919	30	1920	20	1922	36	1930	
	21	1932					
1920	362	1927	165	1932			
1921	365	1922	44	1923	139	1928	
1922	51	1923	155	1924	238	1926	
	54	1928	484	1929	43	1933	
	67	1936	58	1939	247	1940	
1923	319	1925	147	1926	38	1928	
	141	1940					
1924	511	1925	753	1926	28	1931	
	68	1932	249	1939	392	1940	
1925	40	1925	118	1926	99	1927	
	62	1928	48	1929	398	1932	
	38	1937					
1926	197	1929					
1928	198	1932					
1932	80	1941					
1934	31	1936					
1936	24	1940					
1938	129	1941					

1½-IN. WROUGHT-IRON AND STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1870	31	0	31
1876	643	0	643
1881	131	0	131
1882	722	0	722
1883	149	0	149
1884	307	0	307
1885	169	0	169
1887	895	0	895
1888	928	0	928
1889	721	0	721
1890	471	0	471
1891	573	0	573
1892	153	0	153
1893	2,182	0	2,182
1894	1,082	364	718
1895	161	0	161
1896	577	0	577
1897	593	106	487
1898	645	202	443
1899	525	0	525
1900	1,205	0	1,205
1901	299	191	108
1902	133	53	80
1903	15	0	15
1904	667	0	667
1906	273	174	99
1907	109	0	109
1908	971	0	971
1909	1,186	87	1,099
1911	325	140	185
1912	807	385	422
1913	418	179	239
1914	1,209	691	518
1915	380	152	228
1916	1,031	619	412
1917	493	164	329
1918	613	224	389
1919	430	149	281
1921	1,647	939	708
1922	4,283	2,173	2,110
1923	2,346	297	2,049
1924	4,468	1,762	2,706
1925	3,523	2,049	1,474
1926	1,868	1,160	708
1927	1,691	1,482	209
1928	799	604	195
1929	556	556	0
1930	2,060	1,345	715
1931	67	67	0
1932	1,267	710	557
1933	602	185	417

1½-IN. WROUGHT-IRON AND STEEL MAINS
(contd.)

Year	Feet		
	Installed	In Service	Retired
1934	632	490	142
1935	255	255	0
1936	1,697	1,630	67
1937	1,430	1,430	0
1938	277	150	127
1939	953	953	0
1940	966	700	266
1941	2,472	2,472	0
1942	816	816	0
TOTAL	56,897	26,105	30,792

Retirements by Years

Year	Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1870	31	1896						
1876	211	1888	432	1897				
1881	131	1904						
1882	225	1892	200	1893	181	1894		
	116	1895						
1883	149	1928						
1884	307	1886						
1885	169	1886						
1887	559	1895	74	1914	262	1920		
1888	387	1889	348	1894	193	1905		
1889	326	1894	395	1906				
1890	327	1894	144	1911				
1891	106	1892	31	1894	158	1907		
	150	1908	128	1913				
1892	153	1908						
1893	150	1894	62	1895	94	1898		
	1,084	1907	39	1908	656	1910		
	97	1912						
1894	209	1899	181	1908	146	1912		
	182	1932						
1895	66	1900	95	1912				
1896	190	1904	77	1914	310	1929		
1897	142	1910	142	1917	203	1934		
1898	284	1905	124	1913	35	1929		
1899	100	1908	275	1914	150	1934		
1900	132	1906	192	1911	356	1922		
	133	1926	108	1929	284	1937		
1901	75	1905	33	1909				
1902	80	1927						
1903	15	1908						
1904	552	1929	115	1934				
1906	8	1908	91	1922				
1907	109	1908						
1908	267	1915	30	1917	674	1924		
1909	7	1910	157	1911	13	1914		
	327	1923	469	1926	110	1929		
	16	1937						
1911	40	1913	46	1914	99	1929		
1912	53	1916	61	1923	107	1929		

1½-IN. WROUGHT-IRON AND STEEL MAINS
(contd.)

Retirements by Years (contd.)

Year	Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1912	201	1930						
1913	59	1914	180	1924				
1914	300	1924	10	1925	208	1940		
1915	73	1923	155	1932				
1916	12	1920	267	1925	133	1932		
1917	126	1924	87	1930	116	1933		
1918	148	1927	241	1931				
1919	36	1920	245	1939				
1921	297	1922	223	1924	98	1932		
	90	1940						
1922	364	1924	77	1925	95	1926		
	147	1928	328	1930	544	1932		
	122	1937	433	1940				
1923	350	1925	448	1926	321	1927		
	596	1928	259	1929	75	1933		
1924	117	1924	603	1925	23	1926		
	186	1927	185	1928				
	440	1930	44	1933	161	1934		
	654	1939	46	1940	247	1942		
1925	218	1926	115	1929	144	1932		
	291	1939	503	1940	73	1941		
	130	1942						
1926	85	1929	201	1938	24	1939		
	148	1941	250	1942				
1927	16	1931	193	1933				
1928	97	1932	21	1933	77	1934		
1930	263	1937	452	1941				
1932	142	1937	307	1940	108	1941		
1933	267	1939	150	1941				
1934	142	1939						
1936	67	1942						
1938	127	1941						
1940	266	1942						

1½-IN. WROUGHT-IRON AND STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1883	203	0	203
1884	325	0	325
1886	49	0	49
1889	523	0	523
1891	54	54	0
1892	63	0	63
1894	142	0	142
1895	146	0	146
1896	480	0	480
1898	1,610	0	1,610
1899	820	536	284
1900	725	0	725
1901	467	0	467
1902	352	0	352
1903	531	0	531

1½-IN. WROUGHT-IRON AND STEEL MAINS
(contd.)

Year	Feet		
	Installed	In Service	Retired
1904	508	199	309
1906	718	437	281
1907	163	0	163
1909	273	138	135
1910	57	0	57
1911	1,437	392	1,045
1913	444	0	444
1917	244	0	244
1919	342	280	62
1920	1,102	210	892
1921	546	105	441
1922	3,009	808	2,201
1923	2,414	1,432	982
1924	1,414	1,246	168
1925	3,432	1,470	1,962
1926	1,711	1,061	650
1927	527	267	260
1928	398	207	191
1929	175	0	175
1930	1,050	962	88
1931	502	502	0
1932	181	34	147
1934	14	14	0
1936	1,195	1,195	0
1937	1,142	1,142	0
1938	13	13	0
1939	283	283	0
1940	749	749	0
1941	1,123	1,123	0
1942	351	351	0
TOTAL	32,007	15,210	16,797

Retirements by Years

Year	Feet		Feet		Feet	
Installed	Feet	Year	Feet	Year	Feet	Year
1883	203	1928				
1884	273	1894	52	1899		
1886	49	1887				
1889	82	1896	441	1911		
1892	63	1893				
1894	142	1932				
1895	8	1913	138	1926		
1896	480	1912				
1898	30	1912	1,355	1926	225	1932
1899	102	1914	74	1917	108	1933
1900	36	1904	192	1913	290	1922
	207	1928				
1901	467	1911				
1902	173	1911	179	1917		
1903	398	1913	133	1939		
1904	28	1913	125	1931	48	1934
	108	1937				
1906	192	1911	49	1917	40	1928

1½-IN. WROUGHT-IRON AND STEEL MAINS
(contd.)

Retirements by Years (contd.)

Year	Feet		Feet		Feet	
Installed	Feet	Year	Feet	Year	Feet	Year
1907	163	1912				
1909	47	1917	88	1931		
1910	57	1917				
1911	111	1919	163	1925	217	192
	373	1932	181	1941		
1913	251	1921	193	1924		
1917	3	1919	201	1924	13	192
	27	1932				
1919	62	1936				
1920	892	1940				
1921	241	1925	200	1941		
1922	254	1924	135	1925	288	192
	224	1929	365	1930	39	193
	615	1932	19	1934	262	194
1923	131	1925	67	1926	481	193
	102	1940	137	1941	64	194
1924	66	1927	102	1941		
1925	249	1925	127	1927	736	192
	257	1931	543	1932	50	194
1926	650	1939				
1927	260	1931				
1928	191	1929				
1929	175	1932				
1930	74	1932	14	1936		
1932	147	1937				

2-IN. WROUGHT-IRON AND STEEL MAINS

Year	Feet		
	Installed	In Service	Retired
1875	373	0	373
1876	820	0	820
1877	5,368	0	5,368
1880	809	0	809
1881	137	0	137
1883	758	0	758
1884	555	0	555
1885	847	488	359
1886	3,545	0	3,545
1887	2,015	0	2,015
1888	3,838	0	3,838
1889	4,515	0	4,515
1890	865	0	865
1891	1,077	162	915
1892	1,742	212	1,530
1894	504	158	346
1895	2,432	213	2,219
1896	83	0	83
1897	1,688	0	1,688
1898	2,219	688	1,531
1899	407	61	346
1900	284	102	182
1902	507	467	40
1903	27	27	0

2-IN. WROUGHT-IRON AND STEEL MAINS
(contd.)

Year	Feet		
Installed	Installed	In Service	Retired
1904	16	16	0
1906	57	45	12
1907	12	0	12
1908	174	160	14
1909	1,285	81	1,204
1910	806	732	74
1911	1,090	348	742
1912	1,967	851	1,116
1914	76	0	76
1915	546	284	262
1916	2,347	753	1,594
1917	2,286	972	1,314
1919	1,854	0	1,854
1920	1,732	30	1,702
1921	8,297	3,071	5,226
1922	3,231	2,170	1,061
1923	7,344	3,194	4,150
1924	9,550	7,213	2,337
1925	7,230	5,654	1,576
1926	2,040	1,618	422
1927	4,666	3,459	1,207
1928	2,211	1,968	243
1929	1,425	1,425	0
1930	525	525	0
1931	805	805	0
1933	259	259	0
1934	326	326	0
1935	38	38	0
1936	532	532	0
1937	1,656	1,656	0
1938	1,001	640	361
1939	424	424	0
1940	424	424	0
1941	2,913	2,913	0
1942	2,518	2,518	0
TOTAL	107,078	47,682	59,396

Retirements by Years

Year	Installed	Feet	Year	Feet	Year
1875	13	1912	360	1915	
1876	85	1888	250	1896	204 1908
	281	1935			
1877	1,664	1892	586	1895	1,845 1896
	100	1908	68	1912	1,105 1913
1880	14	1890	220	1898	353 1905
	222	1929			
1881	137	1895			
1883	283	1894	475	1899	
1884	365	1914	190	1936	
1885	359	1899			
1886	969	1887	367	1898	323 1899
	1,431	1905	45	1919	410 1936

 2-IN. WROUGHT-IRON AND STEEL MAINS
(contd.)

Retirements by Years (contd.)

Year	Installed	Feet	Year	Feet	Year	Feet	Year
1887	212	1896	195	1905	354	1906	
	708	1908	366	1916	180	1918	
1888	602	1889	385	1890	635	1895	
	1,393	1906	348	1908	475	1923	
1889	1,115	1894	244	1895	544	1896	
	307	1898	690	1908	283	1909	
	1,004	1915	328	1924			
1890	469	1891	219	1915	84	1932	
	93	1936					
1891	116	1896	429	1906	370	1930	
1892	250	1906	246	1908	233	1912	
	236	1915	350	1924	171	1927	
	44	1932					
1894	201	1932	145	1933			
1895	456	1906	188	1912	120	1929	
	200	1930	36	1936	1,219	1940	
1896	83	1905					
1897	92	1905	14	1912	167	1913	
	423	1929	697	1935	295	1938	
1898	102	1906	93	1908	64	1912	
	39	1914	30	1920	354	1924	
	299	1925	144	1930	406	1932	
1899	31	1935	315	1936			
1900	182	1901					
1902	30	1913	10	1934			
1906	12	1912					
1907	12	1908					
1908	14	1919					
1909	137	1916	772	1926	295	1937	
1910	74	1912					
1911	58	1912	9	1913	200	1915	
	138	1921	33	1926	304	1927	
1912	829	1915	14	1932	273	1939	
1914	76	1926					
1915	10	1930	252	1942			
1916	186	1920	449	1930	166	1931	
	793	1934					
1917	333	1920	7	1924	500	1928	
	462	1930	12	1936			
1919	1,854	1921					
1920	90	1921	7	1927	1,035	1933	
	463	1934	107	1939			
1921	253	1921	60	1922	60	1926	
	389	1929	751	1930	570	1931	
	698	1933	82	1934	1,049	1935	
	990	1939	324	1940			
1922	340	1925	208	1926	45	1930	
	38	1931	21	1934	405	1935	
	4	1936					
1923	968	1926	12	1929	123	1931	
	1,248	1932	1,441	1933	323	1934	
	35	1939					

2-IN. WROUGHT-IRON AND STEEL MAINS
(contd.)

Retirements by Years (contd.)

Year	Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1924	558	1929	14	1931	112	1932		
	218	1933	522	1934	81	1935		
	832	1929						
1925	20	1933	1,071	1935	179	1936		
	306	1939						
1926	422	1935						
1927	631	1929	349	1930	130	1936		
	97	1941						
1928	31	1930	208	1935	4	1939		
1938	361	1941						

2½-IN. WROUGHT-IRON AND STEEL MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1939	159	1939	159	0				
1942	0	1942	0	0				
TOTAL	159	159	0					

3-IN. WROUGHT-IRON AND STEEL MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1877	1,063	0	1,063					
1885	90	0	90					
1894	39	0	39					
1895	810	0	810					
1904	14	0	14					
1942	0	0	0					
TOTAL	2,016	0	2,016					

Retirements by Years

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1877	1,063	1894						
1885	90	1909						
1894	39	1912						
1895	11	1898	362	1913	437	1920		
1904	14	1915						

10-IN. STEEL MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1931	28	28	0					
1942	0	0	0					
TOTAL	28	28	0					

16-IN. STEEL MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1929	209	209	0					
1937	44	44	0					
1942	0	0	0					
TOTAL	253	253	0					

18-IN. STEEL MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1940	12,803	12,803	0					
1941	341	341	0					
1942	0	0	0					
TOTAL	13,144	13,144	0					

20-IN. STEEL MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1926	72	72	0					
1936	53	53	0					
1940	318	318	0					
1942	0	0	0					
TOTAL	443	443	0					

24-IN. STEEL MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1915	64	64	0					
1929	7	7	0					
1942	0	0	0					
TOTAL	71	71	0					

30-IN. STEEL MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1909	2,163	2,163	0					
1942	0	0	0					
TOTAL	2,163	2,163	0					

36-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	318	318	0
1929	3,504	3,504	0
1942	0	0	0
TOTAL	3,822	3,822	0

42-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1909	61,210	61,193	17
1926	504	504	0
1929	131	131	0
1931	85	85	0
1942	0	0	0
TOTAL	61,930	61,913	17

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1909	17	1929

48-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1929	18,309	18,309	0
1942	0	0	0
TOTAL	18,309	18,309	0

51-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1929	13	13	0
1942	0	0	0
TOTAL	13	13	0

54-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1929	16,155	16,155	0
1942	0	0	0
TOTAL	16,155	16,155	0

60-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1932	71	71	0
1942	0	0	0
TOTAL	71	71	0

66-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1929	279	279	0
1942	0	0	0
TOTAL	279	279	0

72-IN. STEEL MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1929	23	23	0
1942	0	0	0
TOTAL	23	23	0

¾-IN. COPPER MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1940	60	60	0
1942	0	0	0
TOTAL	60	60	0

1-IN. COPPER MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1940	175	175	0
1941	79	79	0
1942	0	0	0
TOTAL	254	254	0

1½-IN. COPPER MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1941	291	291	0
1942	0	0	0
TOTAL	291	291	0

1½-IN. BRASS MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1941	2	2	0
1942	0	0	0
TOTAL	2	2	0

2-IN. BRASS AND COPPER MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1940	578	578	0
1942	0	0	0
TOTAL	578	578	0

2-IN. CEMENT MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1865	1,297	0	1,297
1866	313	0	313
1942	0	0	0
TOTAL	1,610	0	1,610

Retirements by Years

Year	Feet		Feet		Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1865	230	1886	386	1890	361	1898
	320	1901				
1866	313	1887				

3-IN. CEMENT MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1865	18,144	0	18,144
1866	11,290	0	11,290
1867	4,132	0	4,132
1868	3,077	0	3,077
1869	8,280	0	8,280
1870	4,375	0	4,375
1871	2,467	0	2,467
1942	0	0	0
TOTAL	51,765	0	51,765

Retirements by Years

Year	Feet		Feet		Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1865	956	1884	268	1885	1,452	1886
	4,037	1887	8,908	1888	1,167	1889
	998	1890	358	1898		

3-IN. CEMENT MAINS (contd.)

Retirements by Years (contd.)

Year	Feet		Feet		Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1866	699	1884	45	1885	600	1886
	1,012	1887	707	1888	1,309	1890
	3,885	1891	730	1892	624	1895
	1,507	1898	172	1909		
1867	280	1884	345	1886	860	1887
	361	1888	709	1892	597	1895
	287	1899	644	1905	49	1908
1868	210	1885	226	1886	1,872	1887
	369	1890	400	1898		
1869	1,164	1885	48	1886	1,535	1888
	1,297	1890	1,065	1891	7	1892
	550	1894	1,510	1897	896	1898
	208	1909				
1870	700	1887	700	1888	150	1889
	2,082	1891	130	1893	206	1897
	407	1908				
1871	25	1888	422	1890	1,201	1892
	781	1897	38	1909		

4-IN. CEMENT MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1865	859	0	859
1866	2,253	0	2,253
1867	324	0	324
1868	2,834	0	2,834
1869	1,688	0	1,688
1871	2,312	0	2,312
1873	2,321	0	2,321
1874	301	0	301
1875	5,680	0	5,680
1876	892	0	892
1942	0	0	0
TOTAL	19,464	0	19,464

Retirements by Years

Year	Feet		Feet		Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1865	329	1884	70	1885	42	1886
	32	1890	386	1908		
1866	38	1885	1,109	1887	400	1888
	23	1903	683	1909		
1867	324	1899				
1868	52	1886	34	1890	964	1897
	658	1898	1,126	1904		
1869	48	1885	727	1889	913	1898
1871	46	1890	57	1897	24	1898
	1,204	1900	981	1909		
1873	50	1886	33	1888	370	1890
	1,527	1908	341	1909		
1874	52	1889	249	1906		

4-IN. CEMENT MAINS (contd.)

Retirements by Years (contd.)

Year	Feet	Year	Feet	Year	Feet	Year
Installed						
1875	23	1886	14	1890	28	1891
	210	1906	2,617	1908	227	1909
	127	1911	573	1913	711	1914
	1,150	1915				
1876	140	1904	369	1907	383	1914

6-IN. CEMENT MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1865	7,215	0	7,215
1866	14,714	0	14,714
1867	4,593	0	4,593
1868	1,281	0	1,281
1869	577	0	577
1870	812	0	812
1871	1,300	0	1,300
1873	637	0	637
1874	344	0	344
1875	21,402	0	21,402
1876	577	0	577
1877	135	0	135
1879	150	0	150
1942	0	0	0
TOTAL	53,737	0	53,737

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year
Installed						
1865	1,332	1887	2,159	1891	1,684	1893
	38	1895	319	1899	1,481	1900
	202	1905				
1866	114	1885	5,596	1890	577	1891
	3,147	1893	460	1894	368	1897
	2,246	1898	1,857	1904	349	1909
1867	260	1887	463	1890	1,795	1897
	154	1899	1,921	1905		
1868	232	1890	31	1891	90	1892
	11	1896	805	1898	112	1909
1869	577	1890				
1870	49	1889	45	1891	474	1893
	244	1896				
1871	1,300	1896				
1873	27	1891	42	1896	43	1897
	525	1909				
1874	30	1897	314	1908		
1875	25	1890	1,452	1906	12,646	1908
	412	1909	28	1910	995	1911
	1,373	1912	469	1913	1,416	1914
	2,586	1915				
1876	535	1891	42	1908		
1877	135	1908				
1879	150	1908				

8-IN. CEMENT MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1864	6,076	0	6,076
1865	4,777	0	4,777
1866	1,217	0	1,217
1872	7,149	0	7,149
1873	1,742	0	1,742
1874	3,085	0	3,085
1875	7,014	0	7,014
1879	399	0	399
1942	0	0	0
TOTAL	31,459	0	31,459

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year
Installed						
1864	280	1885	2,530	1890	640	1891
	200	1892	1,512	1897	914	1909
1865	315	1885	1,796	1886	577	1887
	676	1891	527	1892	886	1909
1866	60	1885	1,157	1889		
1872	21	1891	828	1892	1,835	1901
	631	1907	3,834	1908		
1873	249	1897	1,493	1908		
1874	1,001	1908	47	1910	2,037	1914
1875	1,540	1907	1,264	1908	71	1910
	70	1911	94	1912	1,368	1913
	1,252	1914	1,355	1915		
1879	399	1908				

10-IN. CEMENT MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1866	1,410	0	1,410
1871	1,075	0	1,075
1942	0	0	0
TOTAL	2,485	0	2,485

Retirements by Years

Year	Feet	Year
Installed		
1866	1,410	1890
1871	1,075	1888

12-IN. CEMENT MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1864	2,526	0	2,526
1865	3,462	0	3,462
1871	233	0	233
1874	10,420	0	10,420

12-IN. CEMENT MAINS (contd.)

Retirements by Years

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1878		84		0		84		
1882		356		0		356		
1942		0		0		0		
TOTAL		17,081		0		17,081		

Retirements by Years

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1864	2,526	1885						
1865	3,462	1892						
1871	233	1888						
1874	960	1888	28	1897	2,563	1907		
	3,479	1908	2,690	1909	700	1914		
1878	84	1908						
1882	356	1913						

16-IN. CEMENT MAINS

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>						
1874	14,660	0		14,660				
1875	1,546	0		1,546				
1942	0	0		0				
TOTAL	16,206	0		16,206				

Retirements by Years

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1874	318	1890	2,930	1908	7,273	1909		
	4,139	1910						
1875	1,136	1908	410	1909				

20-IN. CEMENT MAINS

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>						
1874	4,365	0		4,365				
1942	0	0		0				
TOTAL	4,365	0		4,365				

20-IN. CEMENT MAINS (contd.)

Retirements by Years

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1874	265	1900	4,100	1909		

24-IN. CEMENT MAINS

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>				
1874	52,675	19,460	33,215			
1875	114	0	114			
1942	0	0	0			
TOTAL	52,789	19,460	33,329			

Retirements by Years

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1874	215	1885	2,814	1911	2,531	1912		
	3,761	1913	13,989	1914	9,905	1936		
1875	114	1908						

8-IN. ASBESTOS-CEMENT MAINS

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>				
1942	3,127	3,127	0			
TOTAL	3,127	3,127	0			

10-IN. ASBESTOS-CEMENT MAINS

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>				
1936	1,232	1,232	0			
1942	0	0	0			
TOTAL	1,232	1,232	0			

Summit, New Jersey

As of December 31, 1940

THE Commonwealth Water Company is a privately-owned company serving a large metropolitan suburban area in Summit, Irvington and West Orange, and vicinities located in Essex, Union and Morris Counties, New Jersey.

Much of the territory served lies along the main line of the Delaware and Lackawanna Railroad extending westerly from Newark for a distance of about 20 mi. The elevation range is over 600 ft. The territory is ideally suited, and chiefly used, for residential purposes. It has had a healthy and steady increase in population over the last 30 years.

At Dec. 31, 1940, the company had 29,659 customers served wholly through meter measurement to an estimated population of 152,000. The system contained 433.5 mi. of main with 2,880 hydrants attached. The average daily pumpage was 10.4 mil gal., equivalent to 68 gpd. per capita, of which approximately 81 per cent was accounted for by meter measurement. About 5 per cent of the water pumped was for industrial use.

Development of the Existing System

The original Commonwealth Water Company was incorporated May 15, 1889, and in June 1889 a contract was made between the company and the township of Summit (now the city of Summit) for the installation of a water works system. Construction was

started and the property placed in operation in the early part of 1890. The original system consisted of wells and a pumping plant located in the Baltusrol Valley and some 5 mi. of distribution mains in Summit.

The company, as it exists today, is the result of the merger, purchase and consolidation of a considerable number of smaller companies. Until 1922 the development, ownership and management continued largely in the hands of the original Commonwealth Water Company. In that year, the American Water Works and Electric Company acquired the company through purchase and it has continued under its ownership and management until the present.

The territory now served includes the city of Summit, the townships of Millburn and Maplewood, the village of South Orange, the boro of New Providence, the townships of Springfield, Stirling, Millington and Meyersville in Passaic Township, the town of Irvington, and the townships of Hillside, Union, West Orange, Chatham, Livingston, Harding and New Providence.

The company has developed four sources of supply, namely: a surface supply at Canoe Brook and well supplies at Canoe Brook, Baltusrol and Short Hills. The largest of these supplies is the combined surface and well supply at Canoe Brook. This supply is located on the north side about mid-

TABLE 1
SUMMARY OF MAINS—SUMMIT, NEW JERSEY

Size, in.	Kind	Total Feet	Identified Pipe						Year of First Instal- lation	Aver- age Age, yr.
			No. of Feet Installed	Per- cent- age of Total	No. of Feet Re- tired	Per- cent- age of Total	No. of Feet in Service	Per- cent- age of Total		
2	Cast-iron unlined	1,524	0	0	0	0	0	0	—	—
3		11,024	0	0	0	0	0	0	—	—
4		211,327	161,831	9.2	5,501	12.2	156,330	9.1	1889	41.5
6		861,310	598,680	34.0	1,283	2.8	597,397	34.8	1889	26.8
8		136,018	87,640	5.0	382	0.8	87,258	5.1	1889	34.3
10		60,619	57,787	3.3	12	0.0	57,775	3.4	1889	44.1
12		42,387	33,430	1.9	0	0	33,430	1.9	1899	29.3
16		37,652	31,952	1.8	0	0	31,952	1.9	1899	22.0
18		2,233	2,233	0.1	0	0	2,233	0.1	1912	28.5
20		4,143	4,143	0.2	0	0	4,143	0.2	1912	28.4
24	Cast-iron cement- lined	14,186	14,186	0.8	0	0	14,186	0.8	1917	23.5
2		5,490	5,490	0.3	0	0	5,490	0.3	1934	2.8
4		803	803	0.1	0	0	803	0.1	1928	4.4
6		454,491	454,491	25.8	207	0.5	454,284	26.5	1927	8.8
8		78,520	78,520	4.5	412	0.9	78,108	4.5	1927	8.1
10		12	12	0.0	0	0	12	0.0	1930	10.5
12		58,508	58,508	3.3	0	0	58,508	3.4	1927	7.8
16		40,728	40,728	2.3	0	0	40,728	2.4	1927	8.0
24		6,297	6,297	0.4	0	0	6,297	0.4	1928	12.5
2		160	160	0.0	0	0	160	0.0	1927	13.5
3	Cast-iron (Universal)	5,920	2,362	0.1	0	0	2,362	0.1	1927	13.5
4		4,325	1,216	0.1	0	0	1,216	0.1	1915	22.3
6		39,521	36,228	2.1	0	0	36,228	2.1	1913	15.4
8		18,026	16,453	1.0	0	0	16,453	1.0	1921	14.1
1		2,102	1,661	0.1	1,581	3.5	80	0.0	1903	15.5
1		7,525	760	0.0	177	0.4	583	0.0	1923	13.4
1½		102	102	0.0	0	0	102	0.0	1923	17.5
1½		5,477	1,492	0.1	0	0	1,492	0.1	1924	10.8
2		19,337	5,964	0.3	188	0.4	5,776	0.3	1924	13.4
2½		1,140	190	0.0	190	0.4	0	0	1924	—
4	Galvanized steel	8,626	0	0	0	0	0	0	—	—
1		7,697	2,533	0.1	1,658	3.7	875	0.1	1902	32.9
1		13,136	9,508	0.5	6,531	14.5	2,977	0.2	1891	35.7
1½		773	0	0	0	0	0	0	—	—
1½		14,331	10,094	0.6	6,236	13.9	3,858	0.2	1896	35.1
2		44,939	36,038	2.0	20,337	45.2	15,701	0.9	1890	40.0
6		348	348	0.0	348	0.8	0	0	1889	—
1		93	62	0.0	0	0	62	0.0	1923	13.0
1	Lead	93	62	0.0	0	0	62	0.0	1923	13.0
TOTAL		2,220,850	1,761,902	100.0	45,043	100.0	1,716,859	100.0		21.9
Percentage of Total			100.00		2.56		97.44			
Average size, in.			6.95		2.21		7.08			

TABLE 1 (contd.)
Mortality Survival Ratios

Size, in.	Kind	No of Feet	Period Covered, yr.	Percentage
4	Cast-iron unlined	161,831	51.5	96.566
6		598,680	51.5	99.592
8		87,640	51.5	99.515
10 and 12		91,217	51.5	99.987
Over 12		52,514	41.5	100.000
2-4	Cast-iron cement-lined	6,293	12.5	100.000
6		454,491	13.5	99.935
8		78,520	13.5	99.035
Over 8		105,545	13.5	100.000
2-8		56,419	27.5	100.000
$\frac{1}{2}$ -1 $\frac{1}{2}$	Galvanized wrought-iron and steel, lead	26,212	48.5	29.485
2-2 $\frac{1}{2}$	Galvanized wrought-iron and steel	42,192	49.5	38.553
6	Wrought-iron	348	15.5	0.000
TOTAL		1,761,902		

TABLE 2
SUMMARY OF VALVES—SUMMIT, NEW JERSEY

Size, in.	Number Installed	Number Identified	Number Retired	Number in Service	Year of First Installation	Average Age, yr.
4	1,463	1,042	65	977	1889	22.0
6	3,486	2,461	16	2,445	1889	10.7
8	193	132	2	130	1889	19.1
10	53	53	1	52	1889	23.2
12	44	28	0	28	1899	10.9
16	33	28	0	28	1912	8.9
18	2	2	0	2	1912	21.5
20	3	3	0	3	1912	10.8
24	7	7	0	7	1917	10.2
TOTAL	5,284	3,756	84	3,672		14.2
Percentage of Total		100.00	2.24	97.76		

Mortality Survival Ratios

Size, in.	Number	Period Covered, yr.	Percentage
4	1,042	44.5	87.178
6	2,461	44.5	98.077
8	132	44.5	97.736
10 and 12	81	44.5	97.619
Over 12	40	21.5	100.000
TOTAL	3,756		

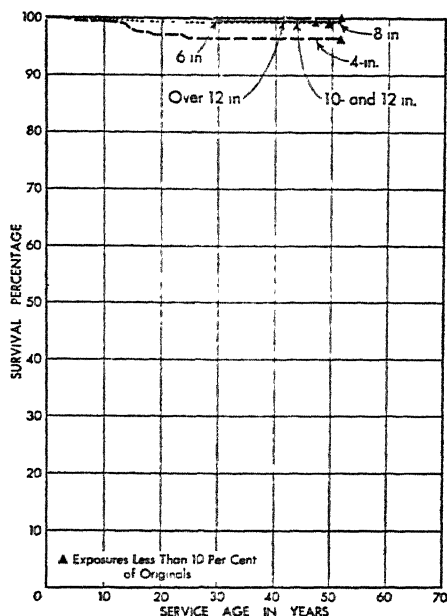


FIG. 1. Mortality Survival Curve—4-24-in. Cast-Iron Unlined Mains—Summit, New Jersey

BASE: Feet SIZE	SURVIVAL: 1889-1940	
in.	EXPOSURES ft.	RETIREMENTS ft.
4	161,831	5,501
6	598,680	1,283
8	87,640	382
10 and 12	91,217	12
Over 12	52,514	0

way of the territory supplied. The company owns at this location about 650 acres of land. The water supply development consists of an underground supply developed by a series of air-lift and pumped wells and a surface supply formed by a storage reservoir of 730-mil.gal. capacity adjacent to Canoe Brook. Water from Canoe Brook, which is pumped into the storage reservoir, is treated and filtered before delivery into the distribution system.

Filters are the modern mechanical type, having a nominal capacity of 4

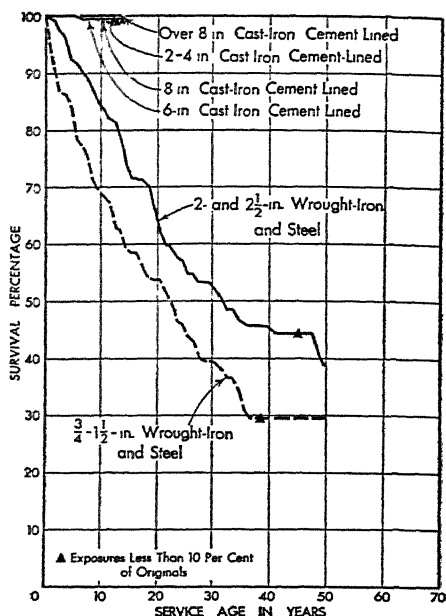


FIG. 2. Mortality Survival Curve— $\frac{3}{4}$ -2 $\frac{1}{2}$ -in. Wrought-Iron and Steel and 2-24-in. Cast-Iron Cement-Lined Mains—Summit, New Jersey

BASE: Feet SIZE	SURVIVAL: 1890-1940	
KIND	EXPOSURES ft.	RETIREMENTS ft.
$\frac{3}{4}$ -1 $\frac{1}{2}$ } Wrought-Iron and Steel	26,082	16,183
2 and 2 $\frac{1}{2}$ } Cast-Iron	42,192	20,715
2-4 } Cement-Lined	6,293	0
6 }	454,491	207
8 }	78,520	412
Over 8 }	105,545	0

mgd. The capacity of the underground supply, as developed at Canoe Brook, is approximately 6 mgd. The pumping station at Canoe Brook, consisting of an engine, pump and boiler room, of fieldstone and masonry construction, houses the boilers, pumping and mechanical equipment. Surface and underground supplies, after delivery into a clear water basin, are pumped directly into the distribution system.

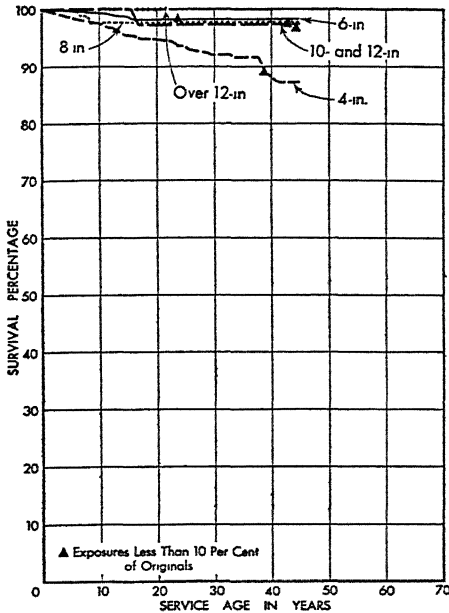


FIG. 3. Mortality Survival Curve—4-24-in. Valves—Summit, New Jersey

BASE: Unit SIZE	SURVIVAL: 1889-1933 EXPOSURES	RETIREMENTS
<i>in.</i>	<i>Units</i>	<i>Units</i>
4	1,042	65
6	2,461	16
8	132	2
10 and 12	81	1
Over 12	40	0

In the main part of the systems there are three storage reservoirs. Two, located in Maplewood, are known as Wyoming Reservoir No. 1 and No. 2, and have a capacity of 1 mil.gal. and 1.7 mil.gal., respectively. The other reservoir, known as West Orange Reservoir, is located in West Orange at the northeastern end of the system. This reservoir has a capacity of 1 mil.gal. All reservoirs are connected to the distribution system and act as equalizers. There are three small booster stations located in the distribution system served by the Canoe Brook Station.

In the same distribution system supplied from the Canoe Brook Station there is a second source of supply in the Short Hills area about 3 mi. to the southeast. The supply at this station is obtained from three pumped wells having an aggregate capacity of approximately 4.5 mgd. Water from the wells is delivered into a clear water basin from which the pumps take suction and deliver directly to the distribution system. This station is a substantial brick pump station housing two diesel-engine-driven centrifugal pumps with a gasoline-engine-driven standby unit. Located in the Short Hills Station are two motor-driven booster pumps which deliver water at higher pressure to a section of the Short Hills territory above the general supply level.

The Summit District territory is supplied from the Baltusrol Station. This system supplies, generally, the territory at the western end of the system. Water from this station is obtained from an underground source by means of infiltration galleries and wells. The water, after being delivered to receiving basins, is pumped into the Summit distribution system, which has an equalizing tank located at a high point. A substantial brick and masonry pump station at Baltusrol houses diesel-engine and steam-driven pumping equipment and boilers.

Basis of Study

The data on pipe and valves were compiled from a study made for the purpose of listing all pipe and valves that had been retired over the life of the property. The study was made coincidentally with an inventory of existing mains. Company records pertaining to size, kind and date of installation were quite complete over the entire plant life except where systems

or parts of systems were purchased. Existing retirement records were checked and supplemented by a comparison of pipe and valves installed with the present existence in specific locations. The unknown pipe shown in the tabulations hereinafter consist of pipe purchased in the system prior to 1923.

The record on valves has not been carried forward beyond the date of the original study which was as of December 1933.

Mortality Survival Study

Mortality studies were made of mains and valves. Table 1 is a summary of the pipe installed, the amount retired and that still in service, as well as other pertinent data. Figures 1 and

2 show the mortality survival curves covering the amount and classification of pipe grouped as shown.

Table 2 and Fig. 3 show a similar study of valves.

A summary of the Class B facilities as of December 1933 is given below.

Causes of Retirement

There does not exist a complete record from which the causes of retirement of mains and valves could be determined.

Acknowledgment

The collection and compilation of data pertaining to the Commonwealth Water Company were carried out by the personnel of the American Water Works and Electric Company, Inc.

SUMMARY OF CLASS B FACILITIES

SUMMIT, NEW JERSEY

Impounding Reservoirs

Storage reservoir, capacity 735 mil.gal., formed by riprap covered earth embankment to which water is pumped from intake chamber formed by a concrete diverting dam across Canoe Brook which is 30 ft. long, maximum height of 6 ft. Constructed in 1929.

Wells

Kelly No. 1—Kelly type concrete cased well, 38-in. diameter, 135 5 ft. deep; cased for 59.5 ft., 75-ft. gravel encased screen; pumped by 24-in. motor-driven centrifugal deep well pump, 1,600-gpm. capacity. Installed in 1926.

Kelly No. 2—Same as No. 1 except pump is 1,050-gpm. capacity. Installed in 1927.

Kelly No. 3—Same as No. 1 except depth of 131 ft.; cased for 43 ft.; pump is 12 in., 1.5-mgd. capacity. Installed in 1932.

Kelly No. 4—Same as No. 1 except depth of 132 ft.; cased for 62 ft.; pump is 12 in., 900-gpm. capacity. Installed in 1933.

Layne A—Layne copperized steel cased well, 24-in. diameter, 121 ft. deep; cased for

85 ft.; pumped by a 15-in. motor-driven centrifugal deep well pump, 730-gpm. capacity. Installed in 1924.

Continental No. 1—Concrete cased well, 38-in. diameter, 105 ft. deep; cased for 55 ft., pumped by a 12-in. motor-driven centrifugal deep well pump, 450-gpm. capacity. Installed in 1929.

Well No. 26—Wrought-iron cased well, 10- and 8-in. diameter, 147 ft. deep, fully cased, slotted pipe strainer, pumped by air lift. Installed in 1910.

Well No. 31—Similar to No. 26, 8- and 6-in. diameter, 300 ft. deep; cased for 125 ft. Installed in 1916 and deepened in 1922.

Well No. 32—Similar to No. 26, 10- and 8-in. diameter, 196 ft. deep; cased for 136 ft. Installed in 1917 and deepened in 1922.

Well No. 33—Similar to No. 26, 10- and 8-in. diameter, 378 ft. deep; cased for 134 ft. Installed in 1917 and deepened in 1922.

Well No. 36—Similar to No. 26, 12-, 10- and 8-in. diameter, 303 ft. deep; cased for 128 ft. Installed in 1921.

Well No. 37—Similar to No. 26, 10- and 8-in. diameter, 304 ft. deep; cased for 101 ft. Installed in 1922.

Well No. 38—Similar to No. 26, 8-in. diameter, 300 ft. deep; cased for 136 ft. Installed in 1922.

Well No. 40—Similar to No. 26, 8-in. diameter, 300 ft. deep; cased for 139 ft. Installed in 1922.

Well No. 41—Similar to No. 26, 8-in. diameter, 303 ft. deep; cased for 142 ft. Installed in 1922.

Well No. 42—Similar to No. 26, 10- and 8-in. diameter, 306 ft. deep, cased for 142 ft. Installed in 1922.

Well No. 30—Gage well, wrought-iron cased well, 10-in. diameter, 137 ft. deep, fully cased. Installed in 1916.

Well No. 15—Wrought-iron cased well; 8-in. diameter, 300 ft. deep, cased for 60 ft.; pumped by motor-driven 8-in. centrifugal deep well pump. Installed in 1933.

Well No. 7—Wrought-iron cased well, 8-in. diameter, 200 ft. deep; cased for 46 ft.; pumped by air lift. Installed in 1910.

Well No. 8—Similar to No. 7 except 201 ft. deep; cased for 61 ft. Installed in 1911.

Well No. 12—Similar to No. 7 except 300 ft. deep; cased for 62 ft. Installed in 1913.

Well No. 14—Similar to No. 7 except 300 ft. deep; cased for 64 ft. Installed in 1913.

Well No. 16—Similar to No. 7 except 300 ft. deep; cased for 43 ft. Installed in 1925.

Well No. 39—Similar to No. 7 except 300 ft. deep; cased for 126 ft. Installed in 1922 and retired in 1930; reason unknown.

Kelly A—Concrete cased well, 38-in. diameter, 77 ft. deep; cased for 28 ft.; pumped by motor-driven 24-in. centrifugal deep well pump, capacity 1.5-mgd. Installed in 1930.

Kelly B—Same as A. Installed in 1931.

Infiltration Gallery

15- and 18-in. open-joint tile pipe laid in tunnels dug from shafts 22 ft. below surface; tunnel backfilled with screened gravel; 815 ft. long. Installed in 1889.

Pumping Equipment

Pump No. 2—Two 8-in. centrifugal pumps in series driven by 9-stage condensing steam turbine, 260 hp., capacity 3 mgd. at 288-ft. head. Installed in 1920.

Pump No. 3—Two 10-in. centrifugal pumps in series driven by 7-stage steam turbine, 300 hp., capacity 4 mgd. at 315-ft. head. Installed in 1922.

Snow Holly—Cross compound, condensing crank and flywheel steam pumping engine, rated 6-mgd. capacity at 325-ft. head. Installed in 1924.

DeLaval—Two-stage centrifugal pump driven by 11-stage steam turbine with attached 320-kw. generator, 970 hp., rated 6-mgd. capacity at 340-ft. head. Installed in 1927.

Baltusrol No. 1—Horizontal, compound, duplex, direct-acting condensing steam pumping engine, rated 1.5-mgd. capacity. Installed in 1910.

Baltusrol No. 2—Horizontal, triple-expansion condensing steam pumping engine, rated 3 0-mgd. capacity. Installed in 1907.

Low Service No. 1—Motor-driven centrifugal pumping unit, 40 hp., rated 8-mgd. capacity at 17-ft. head. Installed in 1929.

Low Service No. 2—Motor-driven centrifugal pumping unit, 20 hp., rated 7-mgd. capacity at 12-ft. head. Installed in 1929.

Low Service No. 3—Motor-driven centrifugal pumping unit, 20 hp., rated 5-mgd. capacity at 10-ft. head. Installed in 1929.

Kelly Well No. 1—Vertical, motor-driven deep well pump, 50 hp., rated 1,600-gpm. capacity at 90-ft. head. Installed in 1926.

Kelly Well No. 2—Vertical, motor-driven deep well pump, 150 hp., rated 1,050-gpm. capacity at 375-ft. head. Installed in 1927.

Kelly Well No. 3—Vertical, motor-driven deep well pump, 40 hp., rated 1.5-mgd. capacity at 90-ft. head. Installed in 1932.

Kelly Well No. 4—Vertical, motor-driven deep well pump, 40 hp., rated 900-gpm. capacity at 81-ft. head. Installed in 1929.

Layne Well A—Motor-driven deep well pump, 30 hp., rated 730-gpm. capacity at 96-ft. head. Installed in 1924.

Continental No. 1—Motor-driven deep well pump, 25 hp., rated 450-gpm. capacity at 105-ft. head. Installed in 1929.

Well No. 15—Motor-driven deep well pump, 15 hp., rated 440-gpm. capacity at 63-ft. head. Installed in 1933.

Kelly A—Motor-driven deep well pump, 25 hp., rated 1.5-mgd. capacity at 55-ft. head. Installed in 1930.

Kelly B—Same as Kelly A. Installed in 1931.

Booster No. 1—Motor-driven centrifugal pump, 20 hp., rated 350-gpm. capacity at 135-ft. head. Installed in 1931.

Booster No. 2—Two-stage motor-driven centrifugal pump, 30 hp., rated 290-gpm. capacity at 265-ft. head. Installed in 1931.

West Orange No. 1—Three-stage motor-driven centrifugal pump, 50 hp., rated 425-gpm. capacity at 296-ft. head. Installed in 1920.

West Orange No. 2—Same as *West Orange No. 1*.

Wyoming No. 1—Motor-driven centrifugal pump, 7.5 hp., rated 130-gpm. capacity at 130-ft. head. Installed in 1927.

Wyoming No. 2—Motor-driven centrifugal pump, 5 hp., rated 100 gpm. at 110-ft. head. Installed in 1927.

Wyoming No. 3—Motor-driven centrifugal pump, 15 hp., rated 325-gpm. capacity at 130-ft. head. Installed in 1932.

Luddington Road Booster—Motor-driven centrifugal pump, 20 hp., rated 2.25-mgd. capacity at 35-ft. head. Installed in 1929.

River Road Booster No. 1—Motor-driven centrifugal pump, 25 hp., rated 350-gpm. capacity at 190-ft. head. Installed in 1929.

River Road Booster No. 2—Motor-driven centrifugal pump, 25 hp., rated 400-gpm. capacity at 175-ft. head. Installed in 1931.

Compressor No. 3—1,500-cfm. steam-driven air compressor, 215 hp. Installed in 1922.

Compressor No. 4—1,574-cfm. motor-driven air compressor, 250 hp. Installed in 1929.

Compressor No. 1—652-cfm. steam-driven air compressor, 96 hp. Installed in 1914.

Snow Unit—Snow steam-engine-driven pump. Installed in 1895 and retired in 1931.

Compressor No. 2—821-cfm. steam-engine-driven air compressor, 113 hp. Installed in 1923.

Compressor No. 3—880-cfm. diesel-engine-driven air compressor, 144 hp. Installed in 1931.

Plant No. 4—Two-stage centrifugal pump, 1,575-gpm. capacity at 370-ft. head, driven by 216-hp. diesel engine with attached generating unit. Installed in 1931.

Plant No. 1—Three-stage centrifugal pump, 1.5-mgd. capacity at 385-ft. head, driven by 220-hp. gasoline engine with attached generating unit. Installed in 1931.

Plant No. 2—Two single-stage centrifugal pumps in series, 1.5-mgd. capacity at 375-ft. head, driven by 240-hp. diesel engine with attached generating unit. Installed in 1931.

Plant No. 3—Same as *No. 2*.

West Orange Booster No. 3—Two-stage centrifugal pump, rated 1-mgd. capacity at 300-

ft. head, driven by 98-hp. gasoline engine. Installed in 1926.

Stirling—Horizontal duplex-belt-driven power pump, 0.1-mgd. capacity, driven by kerosene engine. Installed in 1924.

Low Pressure Steam Pump—Installed in 1894 and retired in 1917.

Manslee—Steam-turbine-driven pump. Installed in 1911 and retired in 1922.

Worthington—Compound steam pump. Installed in 1890 and retired in 1924.

Sweigard—Air compressor. Installed in 1911 and retired in 1922.

Ingersoll Rand—Air compressor. Installed in 1912 and retired in 1924.

Ingersoll Rand—Air compressor. Installed in 1908 and retired in 1924.

Motor-driven centrifugal pump. Installed in 1912 and retired in 1922.

Distribution Reservoirs

Wyoming—Concrete covered reservoir, 65.5 ft. wide by 108 ft. long, 23.3 ft. deep; capacity 1.25 mil gal. Constructed in 1904.

West Orange—Concrete covered reservoir, 69 ft. wide by 102 ft. long, 22 ft. deep; capacity 1 mil. gal. Constructed in 1920.

Baltusrol—Concrete reservoir, wood roof, 24.83 ft. wide by 65.75 ft. long, 14.5 ft. deep; capacity 0.16 mil gal. Constructed in 1896.

Stirling—Brick and concrete reservoir, wood roof, 33 67 ft. long by 33.42 ft. wide, 8.25 ft. deep; capacity 0.065 mil. gal. Constructed in 1927.

Standpipes

West Orange No. 1—Riveted steel standpipe 35-ft. diameter, 35 ft. high; 250,000-gal. capacity. Erected in 1903.

West Orange No. 2—Riveted steel standpipe, 50-ft. diameter, 60 ft. high; 874,000-gal. capacity. Erected in 1928.

Short Hills—Riveted steel standpipe, 60-ft. diameter, 15 ft. high, 317,000-gal. capacity. Erected in 1907.

Druid Hill—Riveted steel standpipe, 40-ft. diameter, 65 ft. high; 600,000-gal. capacity. Erected in 1929.

SUMMARY OF INSTALLATIONS AND RETIREMENTS

SUMMIT, NEW JERSEY

MAINS

2-IN. CAST-IRON UNLINED MAINS				3-IN. CAST-IRON UNLINED MAINS			
Year	Feet			Year	Feet		
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
Unknown*	1,524	1,524	0	Unknown*	11,024	8,809	2,215
1940	0	0	0	1940	0	0	0
TOTAL	1,524	1,524	0	TOTAL	11,024	8,809	2,215

4-IN. CAST-IRON UNLINED MAINS

Year	Feet			Year	Feet		
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1889	9,631	9,330	301	1922	6	6	0
1890	8,477	8,411	66	1924	21	21	0
1891	8,562	8,562	0	1925	23	23	0
1892	8,788	7,971	817	1926	3	3	0
1893	13,440	12,655	785	1927	27	27	0
1894	2,203	2,203	0	1929	50	50	0
1895	6,048	5,823	225	1940	0	0	0
1896	15,607	14,816	719				
1897	7,725	7,725	0	SUBTOTAL	161,831	156,330	5,501
1898	6,089	5,051	1,038	Unknown*	49,496	49,496	0
1899	8,427	7,844	583				
1900	6,176	6,176	0	TOTAL	211,327	205,826	5,501
1901	7,555	7,096	459				
1902	5,415	5,355	60				
1903	6,554	6,554	0				
1904	4,868	4,863	5				
1905	1,909	1,909	0				
1906	3,017	3,017	0				
1907	3,447	3,447	0				
1908	6,713	6,713	0				
1909	7,163	6,948	215				
1910	3,522	3,366	156				
1911	2,460	2,460	0				
1912	2,928	2,928	0				
1913	1,895	1,895	0				
1914	941	941	0				
1915	1,372	1,372	0				
1916	708	708	0				
1917	37	37	0				
1920	24	24	0				

Retirements by Years

Year	Feet	Year	Feet	Year
Installed				
1889	239	1905	62	1906
1890	66	1901		
1892	451	1905	366	1906
1893	785	1917		
1895	45	1917	180	1930
1896	203	1912	588	1914
1898	1,038	1912		
1899	583	1914		
1901	231	1912	228	1914
1902	60	1914		
1904	5	1914		
1909	215	1912		
1910	156	1914		

* Unknown pipe listed consists of pipe purchased in system installed prior to 1923.

SURVIVAL AND RETIREMENT

6-IN. CAST-IRON UNLINED MAINS

Feet				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1889	4,812	4,756	56	1919	3,475	3,475	0
1890	285	285	0	1920	3,814	3,814	0
1891	2,175	2,175	0	1921	11,666	11,666	0
1892	42,216	42,216	0	1922	27,623	27,623	0
1893	5,175	5,175	0	1923	33,056	33,056	0
1894	5,611	5,611	0	1924	32,071	32,071	0
1895	2,417	2,121	296	1925	48,890	48,890	0
1896	4,399	4,367	32	1926	70,650	70,386	264
1897	10,413	10,413	0	1927	15,218	15,218	0
1898	278	278	0	1929	12	12	0
1899	2,644	2,644	0	1930	15	0	15
1900	2,530	2,530	0	1940	0	0	0
1901	10,671	10,463	208				
1902	8,592	8,536	56	SUBTOTAL	598,680	597,397	1,283
1903	4,502	4,502	0	Unknown*	262,630	261,019	1,611
1904	4,348	4,348	0				
1905	10,810	10,810	0	TOTAL	861,310	858,416	2,894
1906	13,919	13,761	158				
1907	10,708	10,708	0	Retirements by Years			
1908	12,448	12,448	0	Year			
1909	24,282	24,282	0	Installed	Feet	Year	
1910	33,441	33,243	198	1889	56	1904	
1911	22,699	22,699	0	1895	296	1907	
1912	24,286	24,286	0	1896	32	1917	
1913	21,808	21,808	0	1901	208	1932	
1914	21,030	21,030	0	1902	56	1929	
1915	18,319	18,319	0	1906	158	1935	
1916	21,800	21,800	0	1910	198	1940	
1917	5,095	5,095	0	1926	264	1929	
1918	477	477	0	1930	15	1931	

8-IN. CAST-IRON UNLINED MAINS

Feet				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1889	5,262	5,151	111	1913	1,616	1,616	0
1892	19,712	19,712	0	1914	2,344	2,344	0
1896	434	434	0	1915	348	348	0
1899	13,218	13,050	168	1916	1,541	1,438	103
1904	1,423	1,423	0	1917	2,848	2,848	0
1905	2,964	2,964	0	1919	1,234	1,234	0
1906	2,746	2,746	0	1921	859	859	0
1907	2,221	2,221	0	1922	1,315	1,315	0
1908	192	192	0	1923	1,695	1,695	0
1909	1,569	1,569	0	1924	3	3	0
1910	2,532	2,532	0	1925	5,203	5,203	0
1911	3,894	3,894	0	1926	3,633	3,633	0
1912	4,815	4,815	0	1927	4,019	4,019	0

* Unknown pipe listed consists of pipe purchased in system installed prior to 1923.

8-IN. CAST-IRON UNLINED MAINS (contd.)

Year Installed	Feet			Retirements by Years		
	Installed	In Service	Retired	Year Installed	Feet	Year
1940	0	0	0	1889	111	1904
SUBTOTAL	87,640	87,258	382	1899	168	1905
Unknown*	48,378	47,637	741	1916	103	1940
TOTAL	136,018	134,895	1,123			

10-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet		
	Installed	In Service	Retired
1889	8,060	8,060	0
1890	33,226	33,226	0
1899	24	24	0
1904	12	0	12
1907	1,646	1,646	0
1909	5,327	5,327	0
1910	616	616	0
1911	2,903	2,903	0
1912	1,202	1,202	0
1917	1,172	1,172	0
1919	1,805	1,805	0
1920	14	14	0
1924	8	8	0
1926	1,420	1,420	0
1927	3	3	0
1928	349	349	0
1940	0	0	0
SUBTOTAL	57,787	57,775	12
Unknown*	2,832	2,832	0
TOTAL	60,619	60,607	12

Retirements by Years

Year Installed	Feet	Year
1904	12	1920

12-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet		
	Installed	In Service	Retired
1899	13,673	13,673	0
1911	3,915	3,915	0
1912	2,019	2,019	0
1917	896	896	0

12-IN. CAST-IRON UNLINED MAINS (contd.)

Year Installed	Feet		
	Installed	In Service	Retired
1920	207	207	0
1923	5,149	5,149	0
1924	7,571	7,571	0
1940	0	0	0
SUBTOTAL	33,430	33,430	0
Unknown*	8,957	8,957	0
TOTAL	42,387	42,387	0

16-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet		
	Installed	In Service	Retired
1899	873	873	0
1904	758	758	0
1912	71	71	0
1915	722	722	0
1916	2,883	2,883	0
1919	1,292	1,292	0
1920	25,353	25,353	0
1940	0	0	0
SUBTOTAL	31,952	31,952	0
Unknown*	5,700	5,700	0
TOTAL	37,652	37,652	0

18-IN. CAST-IRON UNLINED MAINS

Year Installed	Feet		
	Installed	In Service	Retired
1912	2,233	2,233	0
1940	0	0	0
TOTAL	2,233	2,233	0

* Unknown pipe listed consists of pipe purchased in system installed prior to 1923.

20-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	4,126	4,126	0
1928	17	17	0
1940	0	0	0
TOTAL	4,143	4,143	0

24-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1917	14,186	14,186	0
1940	0	0	0
TOTAL	14,186	14,186	0

2-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1934	1,031	1,031	0
1935	408	408	0
1936	414	414	0
1937	53	53	0
1939	2,325	2,325	0
1940	1,259	1,259	0
TOTAL	5,490	5,490	0

4-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1928	6	6	0
1929	38	38	0
1930	58	58	0
1931	2	2	0
1934	11	11	0
1935	138	138	0
1936	100	100	0
1937	186	186	0
1938	154	154	0
1939	61	61	0
1940	49	49	0
TOTAL	803	803	0

6-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	53,935	53,935	0
1928	70,506	70,506	0
1929	83,276	83,276	0
1930	50,934	50,934	0
1931	36,578	36,371	207
1932	9,668	9,668	0
1933	503	503	0
1934	12,294	12,294	0
1935	12,133	12,133	0
1936	18,223	18,223	0
1937	47,996	47,996	0
1938	14,756	14,756	0
1939	11,739	11,739	0
1940	31,950	31,950	0
TOTAL	454,491	454,284	207

Retirements by Years

Year	Feet	Year
Installed		
1931	207	1937

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	3,030	3,030	0
1928	28,201	27,789	412
1929	7,112	7,112	0
1930	4,363	4,363	0
1931	3	3	0
1936	13,098	13,098	0
1937	9,798	9,798	0
1938	6,108	6,108	0
1939	4,268	4,268	0
1940	2,539	2,539	0
TOTAL	78,520	78,108	412

Retirements by Years

Year	Feet	Year
Installed		
1928	412	1937

10-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1930	12	12	0
1940	0	0	0
TOTAL	12	12	0

12-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1927	7,290	7,290	0
1928	11,106	11,106	0
1929	5,652	5,652	0
1930	12	12	0
1931	6,447	6,447	0
1934	4,912	4,912	0
1936	8,087	8,087	0
1939	14,995	14,995	0
1940	7	7	0
TOTAL	58,508	58,508	0

16-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1927	12,620	12,620	0
1928	27	27	0
1929	3,279	3,279	0
1930	10,559	10,559	0
1940	14,243	14,243	0
TOTAL	40,728	40,728	0

24-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1928	6,297	6,297	0
1940	0	0	0
TOTAL	6,297	6,297	0

2-IN. CAST-IRON UNIVERSAL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1927	160	160	0
1940	0	0	0
TOTAL	160	160	0

3-IN. CAST-IRON UNIVERSAL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1927	2,362	2,362	0
1940	0	0	0
SUBTOTAL	2,362	2,362	0
Unknown*	3,558	3,558	0
TOTAL	5,920	5,920	0

4-IN. CAST-IRON UNIVERSAL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1915	440	440	0
1920	776	776	0
1940	0	0	0
SUBTOTAL	1,216	1,216	0
Unknown*	3,109	3,109	0
TOTAL	4,325	4,325	0

6-IN. CAST-IRON UNIVERSAL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1913	506	506	0
1920	1,200	1,200	0
1921	458	458	0
1922	3,324	3,324	0
1923	3,539	3,539	0
1924	1,347	1,347	0
1925	5,341	5,341	0
1926	6,979	6,979	0
1927	10,646	10,646	0
1928	2,626	2,626	0
1929	262	262	0
1940	0	0	0
SUBTOTAL	36,228	36,228	0
Unknown*	3,293	3,293	0
TOTAL	39,521	39,521	0

8-IN. CAST-IRON UNIVERSAL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1921	672	672	0
1923	1,281	1,281	0
1924	568	568	0

* Unknown pipe listed consists of pipe purchased in system installed prior to 1923.

8-IN. CAST-IRON UNIVERSAL MAINS (contd.)

Year	Feet		
Installed	Installed	In Service	Retired
1925	570	570	0
1926	2,267	2,267	0
1927	6,111	6,111	0
1928	4,984	4,984	0
1940	0	0	0
SUBTOTAL	16,453	16,453	0
Unknown*	1,573	1,573	0
TOTAL	18,026	18,026	0

¾-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1903	589	0	589
1905	484	0	484
1906	119	0	119
1907	24	0	24
1911	212	0	212
1912	113	0	113
1922	40	0	40
1925	80	80	0
1940	0	0	0
SUBTOTAL	1,661	80	1,581
Unknown*	441	441	0
TOTAL	2,102	521	1,581

Retirements by Years

Year	Feet	Year	Feet	Year
Installed				
1903	481	1926	108	1927
1905	434	1906	50	1927
1906	38	1927	81	1928
1907	24	1907		
1911	127	1913	85	1928
1912	113	1912		
1922	40	1932		

1-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1923	269	92	177
1925	133	133	0
1929	358	358	0
1940	0	0	0
SUBTOTAL	760	583	177
Unknown*	6,765	3,923	2,842
TOTAL	7,525	4,506	3,019

1-IN. GALVANIZED STEEL MAINS (contd.)

Retirements by Years

Year	Feet	Year
Installed		
1923	177	1924

1½-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1923	102	102	0
1940	0	0	0
TOTAL	102	102	0

1½-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1924	142	142	0
1926	390	390	0
1932	960	960	0
1940	0	0	0
SUBTOTAL	1,492	1,492	0
Unknown*	3,985	450	3,535
TOTAL	5,477	1,942	3,535

2-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1924	816	816	0
1925	506	506	0
1926	32	0	32
1927	1,057	901	156
1928	3,255	3,255	0
1929	298	298	0
1940	0	0	0
SUBTOTAL	5,964	5,776	188
Unknown*	13,373	8,846	4,527
TOTAL	19,337	14,622	4,715

Retirements by Years

Year	Feet	Year
Installed		
1926	32	1929
1927	156	1928

* Unknown pipe listed consists of pipe purchased in system installed prior to 1923.

2½-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1924	190	0	190
1940	0	0	0
SUBTOTAL	190	0	190
Unknown*	950	0	950
TOTAL	1,140	0	1,140

Retirements by Years

Year	Feet	Year
Installed		
1924	190	1928

4-IN. GALVANIZED STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
UNKNOWN*	8,626	8,036	590
1940	0	0	0
TOTAL	8,626	8,036	590

¾-IN. GALVANIZED WROUGHT-IRON MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1902	132	132	0
1903	93	93	0
1904	76	0	76
1905	486	131	355
1906	150	150	0
1907	451	0	451
1908	98	40	58
1909	185	185	0
1910	52	52	0
1911	313	0	313
1912	156	0	156
1913	88	0	88
1920	161	0	161
1922	92	92	0
1940	0	0	0
SUBTOTAL	2,533	875	1,658
Unknown*	5,164	906	4,258
TOTAL	7,697	1,781	5,916

¾-IN. GALVANIZED WROUGHT-IRON MAINS (contd.)

Retirements by Years

Year	Feet	Year
Installed		
1904	76	1909
1905	355	1907
1907	451	1909
1908	58	1911
1911	313	1911
1912	156	1916
1913	88	1913
1920	161	1920

1-IN. GALVANIZED WROUGHT-IRON MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1891	775	0	775
1892	316	194	122
1894	166	166	0
1896	337	337	0
1898	638	0	638
1900	309	0	309
1901	116	0	116
1902	411	411	0
1903	205	116	89
1904	946	0	946
1905	120	0	120
1906	468	181	287
1907	1,298	689	609
1908	272	0	272
1909	207	0	207
1910	1,053	399	654
1911	393	167	226
1912	1,085	0	1,085
1915	223	223	0
1920	170	94	76
1940	0	0	0
SUBTOTAL	9,508	2,977	6,531
Unknown*	3,628	686	2,942
TOTAL	13,136	3,663	9,473

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year
Installed						
1891	294	1905	124	1910	210	1914
	147	1919				
1892	122	1904				
1898	410	1906	228	1912		

* Unknown pipe listed consists of pipe purchased in system installed prior to 1923.

1-IN. GALVANIZED WROUGHT-IRON
MAINS (contd.)

Retirements by Years (contd.)

Year	Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1900	44	1912	122	1915	143	1927		
1901	116	1928						
1903	89	1928						
1904	673	1909	137	1912	136	1940		
1905	120	1940						
1906	287	1912						
1907	396	1928	145	1929	68	1937		
1908	55	1912	217	1916				
1909	207	1940						
1910	502	1910	95	1911	57	1925		
1911	226	1912						
1912	246	1913	40	1917	235	1921		
	564	1924						
1920	76	1927						

1½-IN. GALVANIZED WROUGHT-IRON MAINS

Year	Installed	In Service	Retired
Unknown*	773	753	20
1940	0	0	0
TOTAL	773	753	20

1½-IN. GALVANIZED WROUGHT-IRON MAINS

Year	Installed	In Service	Retired
1896	506	0	506
1898	141	0	141
1899	694	694	0
1900	1,141	260	881
1901	1,189	74	1,115
1902	406	119	287
1903	849	517	332
1904	365	0	365
1905	680	0	680
1906	944	446	498
1907	910	573	337
1908	342	126	216
1909	50	0	50
1910	546	71	475
1911	441	441	0
1912	890	537	353
1940	0	0	0
SUBTOTAL	10,094	3,858	6,236
Unknown*	4,237	598	3,639
TOTAL	14,331	4,456	9,875

Retirements by Years

Year	Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1896	230	1906	276	1928				
1898	141	1911						
1900	42	1911	239	1912	238	1914		
	362	1925						
1901	89	1903	64	1904	120	1905		
	178	1912	16	1914	43	1927		
	345	1928	260	1936				
1902	271	1911	16	1912				
1903	66	1911	266	1937				
1904	127	1909	158	1912	80	1916		
1905	269	1912	411	1923				
1906	448	1911	50	1912				
1907	192	1912	145	1929				
1908	216	1915						
1909	50	1930						
1910	171	1914	304	1927				
1912	169	1929	184	1938				

2-IN. GALVANIZED WROUGHT-IRON MAINS

Year	Installed	In Service	Retired
1890	232	0	232
1891	4,932	1,340	3,592
1892	5,148	1,451	3,697
1893	2,302	96	2,206
1894	729	0	729
1895	2,280	120	2,160
1896	2,425	1,174	1,251
1897	1,822	1,143	679
1898	3,518	1,496	2,022
1899	3,823	3,570	253
1900	322	322	0
1901	354	0	354
1902	920	448	472
1903	292	40	252
1904	893	442	451
1905	1,270	169	1,101
1907	371	69	302
1909	411	411	0
1910	945	708	237
1911	867	867	0
1912	1,042	1,042	0
1913	572	508	64
1914	232	232	0
1919	53	53	0
1920	283	0	283
1940	0	0	0
SUBTOTAL	36,038	15,701	20,337
Unknown*	8,951	1,497	7,454
TOTAL	44,989	17,198	27,791

* Unknown pipe listed consists of pipe purchased in system installed prior to 1923.

2-IN. GALVANIZED WROUGHT-IRON
MAINS (contd.)

<i>Retirements by Years</i>						
<i>Year</i>						
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1890	232	1901				
1891	625	1895	160	1897	733	1899
	623	1904	878	1905	320	1916
	88	1923	104	1927	61	1940
1892	81	1895	82	1896	757	1905
	348	1911	1,119	1912	588	1915
	14	1916	253	1917	182	1919
	273	1940				
1893	470	1895	74	1904	246	1905
	60	1906	225	1911	190	1912
	302	1914	299	1917	340	1927
1894	276	1903	327	1913	126	1919
1895	213	1898	322	1899	128	1907
	272	1909	151	1912	331	1914
	256	1915	265	1916	222	1930
1896	52	1904	495	1905	333	1915
	10	1927	361	1936		
1897	14	1904	206	1907	12	1914
	447	1927				
1898	13	1900	163	1901	320	1903
	52	1904	457	1905	171	1911
	566	1912	125	1916	155	1919
1899	210	1905	27	1928	16	1931
1901	52	1903	54	1904	206	1907
	42	1912				
1902	29	1904	28	1912	15	1914
	212	1915	188	1927		
1903	140	1912	112	1937		
1904	8	1909	80	1912	363	1936
1905	394	1915	277	1916	430	1936
1907	302	1911				
1910	111	1932	126	1937		
1913	64	1940				
1920	283	1922				

6-IN. WROUGHT-IRON MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	258	0	258
1894	90	0	90
1940	0	0	0
TOTAL	348	0	348

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>		
1889	258	1904
1894	90	1905

1-IN. LEAD MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1923	27	27	0
1931	35	35	0
1940	0	0	0
	—	—	—
SUBTOTAL	62	62	0
Unknown*	31	0	31
	—	—	—
TOTAL	93	62	31

* Unknown pipe listed consists of pipe purchased in system installed prior to 1923.

VALVES

4-IN. VALVES

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1889	21	18	3	1914	40	39	1
1890	41	38	3	1915	31	31	0
1891	16	14	2	1916	42	41	1
1892	17	14	3	1917	40	39	1
1893	13	10	3	1918	5	5	0
1894	4	4	0	1919	6	6	0
1895	13	11	2	1920	26	25	1
1896	19	18	1	1921	17	16	1
1897	13	13	0	1922	31	31	0
1898	16	13	3	1923	33	31	2
1899	33	28	5	1924	12	11	1
1900	12	9	3	1925	15	15	0
1901	26	23	3	1926	21	19	2
1902	22	20	2	1927	30	30	0
1903	14	13	1	1928	20	20	0
1904	16	16	0	1929	20	20	0
1905	53	48	5	1930	14	14	0
1906	36	34	2	1931	11	11	0
1907	17	15	2	1932	11	11	0
1908	22	20	2	1933	1	1	0
1909	36	31	5				
1910	27	25	2	SUBTOTAL	1,042	977	65
1911	40	38	2	Unknown*	421	421	0
1912	67	66	1				
1913	22	22	0	TOTAL	1,463	1,398	65

Retirement by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1889	1	1905	2	1906				1906	2	1931				
1890	1	1904	1	1928	1	1931		1907	1	1923	1	1929		
1891	1	1929	1	1930				1908	2	1931				
1892	1	1902	1	1905	1	1906		1909	3	1911	2	1912		
1893	1	1912	1	1926	1	1931		1910	1	1914	1	1924		
1895	1	1902	1	1905				1911	1	1912	1	1917		
1896	1	1912						1912	1	1912				
1898	1	1902	1	1912	1	1927		1914	1	1925				
1899	1	1907	2	1911	1	1912		1916	1	1927				
	1	1926						1917	1	1930				
1900	2	1905	1	1907				1920	1	1930				
1901	1	1912	1	1927				1921	1	1930				
1903	1	1914						1923	1	1925	1	1927		
1905	1	1912	1	1916	1	1926		1924	1	1929				
	1	1928	1	1931				1926	1	1927	1	1929		

* Unknown valves listed consist of valves purchased in system installed prior to 1923.

6-IN. VALVES

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1889	10	7	3	1915	36	36	0
1891	1	1	0	1916	48	48	0
1892	60	59	1	1917	13	13	0
1893	5	5	0	1918	1	1	0
1894	6	3	3	1919	6	6	0
1895	2	2	0	1920	13	13	0
1896	3	3	0	1921	23	21	2
1897	10	10	0	1922	45	45	0
1899	3	3	0	1923	66	66	0
1900	3	2	1	1924	93	92	1
1901	7	7	0	1925	164	164	0
1902	8	8	0	1926	258	258	0
1903	6	6	0	1927	288	288	0
1904	12	11	1	1928	329	329	0
1905	16	16	0	1929	303	303	0
1906	21	21	0	1930	149	148	1
1907	18	18	0	1931	142	142	0
1908	12	12	0	1932	38	38	0
1909	27	27	0	1933	3	3	0
1910	48	48	0				
1911	42	40	2	SUBTOTAL	2,461	2,445	16
1912	45	45	0	Unknown*	1,025	1,006	19
1913	45	44	1				
1914	33	33	0	TOTAL	3,486	3,451	35

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1889	3	1904						1911	1	1919	1	1924		
1892	1	1902						1913	1	1920				
1894	1	1902	1	1905	1	1910		1921	2	1923				
1900	1	1912						1924	1	1924				
1904	1	1910						1930	1	1931				

8-IN. VALVES

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1889	6	6	0	1914	3	3	0
1892	21	21	0	1915	1	1	0
1896	1	1	0	1916	2	2	0
1899	4	3	1	1917	5	5	0
1903	1	1	0	1919	2	1	1
1904	1	1	0	1921	1	1	0
1905	4	4	0	1923	3	3	0
1906	4	4	0	1924	1	1	0
1907	2	2	0	1925	7	7	0
1908	1	1	0	1926	1	1	0
1909	1	1	0	1927	13	13	0
1911	3	3	0	1928	22	22	0
1912	7	7	0	1929	10	10	0
1913	1	1	0				

* Unknown valves listed consist of valves purchased in system installed prior to 1923.

SURVIVAL AND RETIREMENT

8-IN. VALVES (contd.)

<i>Year Installed</i>	<i>Number</i>			<i>Retirements by Years</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Year Installed</i>	<i>Number</i>	<i>Year</i>
1930	3	3	0	1899	1	1905
1931	1	1	0	1919	1	1927
1933	0	0	0			
SUBTOTAL	132	130	2			
Unknown*	61	58	3			
TOTAL	193	188	5			

10-IN. VALVES

<i>Year Installed</i>	<i>Number</i>			<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1889	5	5	0	1924	3	3	0
1890	9	9	0	1926	3	3	0
1896	1	1	0	1927	2	2	0
1899	1	1	0	1928	3	3	0
1904	1	0	1	1930	2	2	0
1907	1	1	0	1931	1	1	0
1908	1	1	0	1933	0	0	0
1909	3	3	0				
1910	1	1	0	TOTAL	53	52	1
1911	3	3	0				
1912	4	4	0				
1916	1	1	0				
1917	4	4	0				
1919	1	1	0				
1923	3	3	0				

<i>Retirements by Years</i>		
<i>Year Installed</i>	<i>Number</i>	<i>Year</i>
1904	1	1920

12-IN. VALVES

<i>Year Installed</i>	<i>Number</i>			<i>Year Installed</i>	<i>Number</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1899	3	3	0	1930	2	2	0
1911	2	2	0	1931	1	1	0
1912	1	1	0	1933	0	0	0
1917	1	1	0				
1923	1	1	0	SUBTOTAL	28	28	0
1924	2	2	0	Unknown*	16	16	0
1927	2	2	0				
1928	7	7	0	TOTAL	44	44	0
1929	6	6	0				

* Unknown valves listed consist of valves purchased in system installed prior to 1923.

16-IN. VALVES			
Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	1	1	0
1915	2	2	0
1919	1	1	0
1920	8	8	0
1927	4	4	0
1928	2	2	0
1929	1	1	0
1930	4	4	0
1931	5	5	0
1933	0	0	0
	—	—	—
SUBTOTAL	28	28	0
Unknown*	5	5	0
	—	—	—
TOTAL	33	33	0

18-IN. VALVES			
Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	2	2	0
1933	0	0	0
	—	—	—
TOTAL	2	2	0

20-IN. VALVES			
Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	1	1	0
1928	2	2	0
1933	0	0	0
	—	—	—
TOTAL	3	3	0

24-IN. VALVES			
Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1917	3	3	0
1928	4	4	0
1933	0	0	0
	—	—	—
TOTAL	7	7	0

* Unknown valves listed consist of valves purchased in system installed prior to 1923.

Syracuse (Suburban), New York

As of December 31, 1940

THE Syracuse plant of the New York Water Service Corporation provides water service to an area suburban to the city of Syracuse, including parts of the towns of Marcellus, Camillus, Geddes, Salina, DeWitt, Manlius, Clay and Cicero and excluding the villages of Marcellus, East Syracuse, Solvay, Liverpool, Minoa and separate water districts within the above-mentioned towns. It also furnishes standby service within the corporate limits of the city of Syracuse with provision that the water should be used solely in cases of emergency. The company also sells water at wholesale rates for redistribution to water districts, including Camillus, Split Rock, Gulf, West Genessee Park, Fairmont, Syracuse Gardens, City View and Cicero and the incorporated villages of Liverpool, Solvay and Minoa. All service is rendered through meters.

The service area is chiefly residential and typical suburban territory surrounding Syracuse in Onondaga County in the central part of New York State. Some large industries are located in the area served.

At the date of the study the company had in service approximately 87.5 mi. of pipelines, including 416 valves and 275 fire hydrants. During 1940 the company furnished 6.3 mgd. to 2,816 customers, including ten water districts and nine large industries. Of the 6.3

mgd. approximately 5.0 mgd. was furnished to the large industries, which include the New York Central Railroad, Marcellus & Otisco Railroad Company and Solvay Process Company. The remaining 1.33 mgd. was used in the area and by the ten water districts which have a population of 29,000. This is equivalent to about 46 gpd. per capita.

Development of the Existing System

The original service in the territory was furnished by the Onondaga County Suburban Water Company, incorporated in April 1907. On Nov. 1, 1907, the name was changed to Syracuse Suburban Water Company. Plant construction started shortly after the first of 1908 and the first sale of water was in June 1909.

On Nov. 30, 1926, the property was acquired by the New York Water Service Corporation, a member of the Federal Water Service Company, and the name of the company was changed to the Onondaga Water Service Corporation. On May 7, 1929, the property was merged with and became the Syracuse plant of the New York Water Service Corporation.

The company's source of water supply is Lake Otisco, located in the town of Marcellus, Onondaga County, some 18 mi. southwest of Syracuse. The lake is owned by the state of New York

TABLE 1
SUMMARY OF MAINS
SYRACUSE (SUBURBAN), NEW YORK

Size, <i>in.</i>	Kind	No of Feet In- stalled	Percent- age of Total	No. of Feet Retured	Percent- age of Total	No of Feet in Service	Percent- age of Total	Year of First In- stallation	Average Age, <i>yr.</i>
4	Cast-iron unlined	1,860	0.4	0	0.0	1,860	0.4	1910	17.8
6		35,838	7.8	50	0.4	35,788	8.1	1910	18.4
8		26,480	5.8	239	1.9	26,241	5.9	1910	26.5
10		2,023	0.5	0	0	2,023	0.5	1910	30.5
12		15,573	3.4	146	1.2	15,427	3.5	1910	28.9
16		55,603	12.2	11,655	94.4	43,948	9.9	1910	28.6
20		77,904	17.1	17	0.1	77,887	17.5	1910	30.4
24	Cast-iron cement-lined	87,770	19.2	18	0.1	87,752	19.7	1910	15.0
6		98,861	21.6	82	0.7	98,779	22.2	1928	9.5
8		23,307	5.1	7	0.1	23,300	5.2	1928	10.1
12		31,558	6.9	135	1.1	31,423	7.1	1929	10.5
10		Galvanized wrought-iron	105	0.0	0	0.0	105	0.0	1910
TOTAL		456,882	100.0	12,349	100.0	444,533	100.0		18.8
Percentage of Total		100.00		2.70		97.03			
Average Size, <i>in.</i>		13.9		15.7		13.9			

Mortality Survival Ratios

Size, <i>in.</i>	Kind	No of Feet	Period Covered <i>yr.</i>	Percentage
4	Cast-iron unlined	1,860	30.5	100.000
6		35,838	30.5	99.460
8		26,480	30.5	99.097
10 and 12		17,596	30.5	99.110
Over 12		221,277	30.5	92.114
6	Cast-iron cement-lined	98,861	12.5	99.894
8		23,307	12.5	99.970
12		31,558	11.5	99.569
10	Galvanized wrought-iron	105	30.5	100.000
TOTAL		456,882		

but the flood rights around it are owned by the company. The legislature, in 1907, granted the Onondaga County Suburban Water Company the right to construct and maintain a dam, intake pipe and accessories necessary to impound an additional supply of water in Otisco Lake for the purpose of supply-

ing pure and wholesome water to municipalities under certain restrictions and conditions.

Besides protecting the state against all claims and demands of riparian owners on Lake Otisco, which required the securing of the riparian rights along the shores and the outlet of the lake, the

SURVIVAL AND RETIREMENT

TABLE 2
SUMMARY OF VALVES
SYRACUSE (SUBURBAN), NEW YORK

Size, in.	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, yr.
4	7	0	7	1910	24.9
6	244	6	238	1910	17.2
8	57	4	53	1910	20.5
10	1	0	1	1910	30.5
12	38	0	38	1910	17.1
16	32	4	28	1910	17.7
20	31	0	31	1910	28.5
24	21	0	21	1910	13.2
TOTAL	431	14	417		18.4
Percentage of Total	100.00	3.25	96.75		

Mortality Survival Ratios

Size, in.	Number	Period Covered, yr.	Percentage
4	7	30.5	100.000
6	244	30.5	93.527
8	57	30.5	86.667
10 and 12	39	30.5	100.000
Over 12	84	30.5	91.400
TOTAL	431		

TABLE 3
SUMMARY OF HYDRANTS
SYRACUSE (SUBURBAN), NEW YORK

Size, in.	Number Installed	Number Retired	Number in Service	Year of First Installation	Average Age, yr.	Mortality Survival Percentage
4	34	6	28	1910	23.9	73.690
5	219	4	215	1927	9.6	97.873
TOTAL	253	10	243		11.3	
Percentage of Total	100.00	3.95	96.05			

company was required to furnish water to the Fair Grounds of the State Fair Commission.

This act gave the company the right to impound for and withdraw 5 mgd. from the lake. In 1922 the company

received permission to take 11 mgd. In 1909 the company built a masonry dam and earthen embankment 127 ft. long and 21.5 ft. high, with the spillway 786.6 ft. above sea level.

Water is taken from Otisco Lake

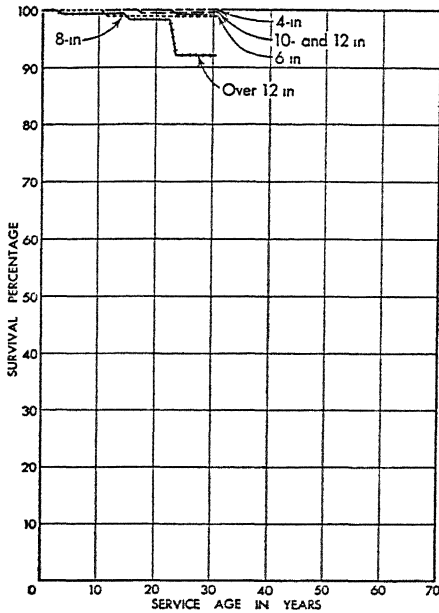


FIG. 1. Mortality Survival Curve—4-24-in. Cast-Iron Unlined Mains—Syracuse (Suburban), New York

BASE: Feet	SURVIVAL: 1910-1940	
SIZE	EXPOSURES	RETIREMENTS
in.	ft.	ft.
4	1,860	0
6	35,838	50
8	26,480	239
10 and 12	17,596	148
Over 12	221,277	11,690

through a timber crib located approximately 6,200 ft. south of the dam with which it is connected by 6,174 ft. of 24-in. diameter, Class A cast-iron pipe. The intake is located about 18 ft. below the surface of the lake. Up to approximately 8.3 mgd. can flow through the transmission mains by gravity and when the daily draft exceeds this amount pumping is required.

The primary pumping station is located in the town of Marcellus just below the dam. It consists of a one-story building with substructure, 22 ft.

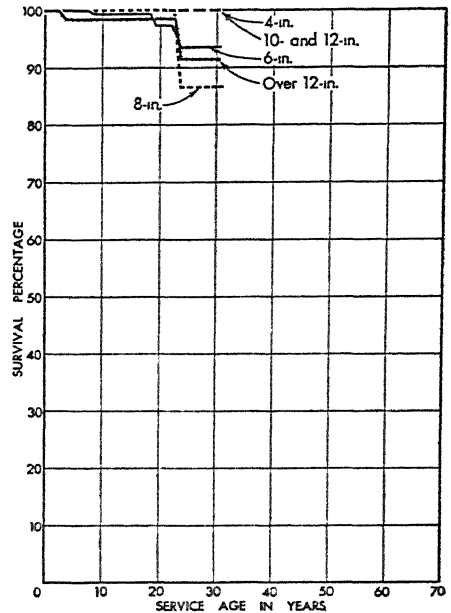


FIG. 2. Mortality Survival Curve—4-24-in. Valves—Syracuse (Suburban), New York

BASE: Unit	SURVIVAL: 1910-1940	
SIZE	EXPOSURES	RETIREMENTS
in.	Units	Units
4	7	0
6	244	6
8	57	4
10 and 12	39	0
Over 12	84	4

deep, housing one 6,000 gpm., 150-hp. motor-driven centrifugal pump and a similar 7,000-gpm. pump driven by a 150-hp. gasoline engine.

Auxiliary booster pumping facilities are located in a building known as the Wolf Street Booster Station situated some 1,000 ft. northeast of the north-east corporate limits of Syracuse. The pump room contains a centrifugal pump of 2,800-gpm. capacity driven by a 100-hp. electric motor which is used to increase the delivery and pressure to the territory lying north and east of the booster station.

TABLE 4
CAUSES OF RETIREMENTS OF MAINS

Size, in.	Kind	Length, ft.	Life, yr.	Cause of Retirement	Salvage, ft.
6	Cast-iron unlined	50	23.5	Blowoff on abandoned 16-in. main	—
		50			0
8	Cast-iron unlined	239	11.5	Flanged pipe canal crossing, canal filled in	239
		239			239
12	Cast-iron unlined	62	17.5	Replaced by 16-in. main and booster pump connection	52
		62			52
16	Cast-iron unlined	708	3.5	Relocated because of new railroad tracks	—
		1,581	15.5	Laid in fill, abandoned because of leaks	—
		100	18.5	Relocated because of sewer construction	100
		39	19.5	Cut-in of 16-in. valve	39
		9,227	23.5	Not needed after 24-in. main laid; 7,259 ft. abandoned under 20-ft. railroad fill	1,968
		11,655			2,107
20	Cast-iron unlined	10	3.5	Cut-in of valve	—
		7	27.5	Cut-in of valve	5
		17			5
24	Cast-iron unlined	18	19.5	Cut-in of valve	—
		18			0
6	Cast-iron cement-lined	16	8.5	Blowoff on abandoned 12-in. creek crossing	0
		66	9.5	Relocated because of sewer construction	66
		82			66
8	Cast-iron cement-lined	7	1.5	Cross cut-in	—
		7			0
12	Cast-iron cement-lined	9	1.5	Cut-in of valve	6
		126	8.5	Bridge construction	—
		135			6
12	Ward	84	23.5	Connection with 12-in. main abandoned	—
		84			0
	Total	12,349			2,475

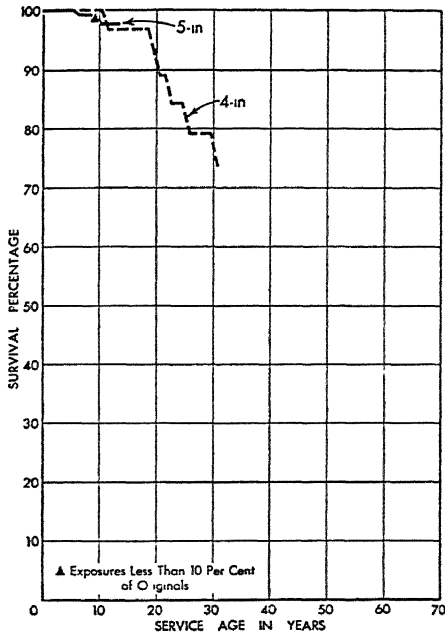


FIG. 3. Mortality Survival Curve—4- and 5-in. Hydrants—Syracuse (Suburban), New York

BASE: Unit	SURVIVAL: 1910-1940	
SIZE	EXPOSURES	RETIREMENTS
in.	Units	Units
4	34	6
5	219	4

Water is delivered from Lake Otisco through the original transmission main, constructed in 1908-1909, of 12-, 16-, 20- and 24-in. cast-iron pipe to the various districts, towns and villages served. In 1928-1929 the original line was paralleled with 87,752 ft. of 24-in. Class B cast-iron pipe, and interconnected at four points.

Water is treated with liquid chlorine and ammonium sulfate fed at the gate and chemical house at Lake Otisco.

Water storage facilities in the distribution system include an earth embankment reservoir located in the town

of Camillus, known as Fairmont Reservoir. It is 265 ft. in diameter and has a capacity of 5 mil.gal. It was constructed in 1909 with a water surface elevation of 609. There is also an elevated steel tank, constructed in 1930. It is 40 ft. in diameter and 20 ft. high, with a capacity of 0.25 mil.gal. and overflow of elevation of 555 ft.

Basis of Study

The records of the system pertaining to the transmission and distribution mains, valves and hydrants are stated to be complete from the date of installation in 1910.

Mortality Survival Study

Mortality studies were made of cast-iron mains, valves and hydrants. Table 1 is a summary of the pipe installed, retired and the amount remaining in service, together with other pertinent data. Figure 1 shows the mortality survival curves covering the record of the amount and sizes of pipe grouped as shown.

Tables 2 and 3 are similar summaries of valves and hydrants, with Figs. 2 and 3 representing the applicable mortality survival curves.

Causes of Retirement

The causes of retirement of mains, valves and hydrants are given in Tables 4, 5 and 6.

Acknowledgment

The collection and compilation of data pertaining to the Syracuse Plant were under the general supervision of E. L. Heyser, Chief Valuation Engineer of the New York Water Service Corporation.

SURVIVAL AND RETIREMENT

TABLE 5
CAUSES OF RETIREMENT OF VALVES
SYRACUSE (SUBURBAN), NEW YORK

Size, in.	Number	Life, yr.	Cause of Retirement	Number Salvaged
6	1	8.5	Blowoff abandoned	—
	2	9.5	Pipe replaced and blowoff abandoned	1
	3	23.5	Blowoff on abandoned 16-in. main	—
	<hr/> 6			<hr/> 1
8	4	23.5	Retired in connection with retirement of 16-in. main	—
	<hr/> 4			<hr/> 0
16	1	3.5	Relocated because of new railroad Line abandoned	1
	3	23.5		3
	<hr/> 4			<hr/> 4
TOTAL	14			5

TABLE 6
CAUSES OF RETIREMENT OF HYDRANTS
SYRACUSE (SUBURBAN), NEW YORK

Size, in.	Number	Life, yr.	Cause of Retirement	Salvage
4	1	11.5	No record	0
	1	19.5	Damaged by auto	0
	1	20.5	Removed	1
	1	22.5	Removed	1
	1	25.5	Replaced at different location	1
	1	30.5	Hydrant no longer wanted	1
	<hr/> 6			<hr/> 4
5	1	6.5	Hydrant no longer wanted	1
	1	9.5	Removed because of sewer construction	1
	2	10.5	One private, no longer wanted	0
	<hr/> 4		One damaged by auto, damages collected	<hr/> 3
TOTAL	10			7

SUMMARY OF INSTALLATIONS AND RETIREMENTS
SYRACUSE (SUBURBAN), NEW YORK

MAINS

4-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	38	38	0
1923	1,822	1,822	0
1940	0	0	0
TOTAL	1,860	1,860	0

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	8,902	8,852	50
1912	362	362	0
1918	31	31	0
1920	533	533	0
1921	929	929	0
1925	4,764	4,764	0
1926	2,009	2,009	0
1927	17,897	17,897	0
1929	411	411	0
1940	0	0	0
TOTAL	35,838	35,788	50

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>		
1910	50	1933

8-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	14,368	14,129	239
1912	606	606	0
1915	6,137	6,137	0
1918	118	118	0
1920	695	695	0
1921	239	239	0
1923	2,802	2,802	0
1927	1,503	1,503	0
1929	12	12	0
1940	0	0	0
TOTAL	26,480	26,241	239

8-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>		
1910	239	1921

10-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	2,023	2,023	0
1940	0	0	0
TOTAL	2,023	2,023	0

12-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	12,257	12,173	84
1912	2,097	2,035	62
1927	1,219	1,219	0
1940	0	0	0
TOTAL	15,573	15,427	146

Retirements by Years

<i>Year</i>	<i>Feet</i>	<i>Year</i>
<i>Installed</i>		
1910	84	1933
1912	62	1929

16-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	50,711	39,056	11,655
1913	772	772	0
1916	20	20	0
1925	1,620	1,620	0
1928	105	105	0
1929	467	467	0
1933	1,908	1,908	0
1940	0	0	0
TOTAL	55,603	43,948	11,655

16-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years

Year	Installed	Feet	Year	Feet	Year	Installed	Feet
1910	708	1913	1,581	1925	100	1928	
	39	1929	9,227	1933			

20-IN. CAST-IRON UNLINED MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1910	77,311	77,294	17					
1913	308	308	0					
1929	279	279	0					
1936	6	6	0					
1940	0	0	0					
TOTAL	77,904	77,887	17					

Retirements by Years

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1910	10	1913	7	1937				

24-IN. CAST-IRON UNLINED MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1910	15,997	15,979	18					
1929	71,735	71,735	0					
1931	38	38	0					
1940	0	0	0					
TOTAL	87,770	87,752	18					

Retirements by Years

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1910	18	1929						

6-IN. CAST-IRON CEMENT-LINED MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1928	8,477	8,477	0					
1929	18,911	18,911	0					
1930	47,910	47,828	82					
1931	2,028	2,028	0					
1934	4,429	4,429	0					
1935	6,539	6,539	0					
1936	2,837	2,837	0					
1937	4,966	4,966	0					
1939	1,109	1,109	0					
1940	1,655	1,655	0					
TOTAL	98,861	98,779	82					

6-IN. CAST-IRON CEMENT-LINED MAINS (contd.)

Retirements by Years

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1930	16	1938	66	1939				

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1928	5,712	5,712	0					
1930	14,795	14,795	0					
1931	31	31	0					
1934	103	103	0					
1936	1,023	1,023	0					
1939	1,643	1,636	7					
1940	0	0	0					
TOTAL	23,307	23,300	7					

Retirements by Years

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1939	7	1940						

12-IN. CAST-IRON CEMENT-LINED MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1929	1,297	1,297	0					
1930	30,073	29,938	135					
1931	9	9	0					
1933	37	37	0					
1937	142	142	0					
1940	0	0	0					
TOTAL	31,558	31,423	135					

Retirements by Years

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1930	9	1931	126	1938				

10-IN. GALVANIZED WROUGHT-IRON MAINS

Year	Installed	Feet	Year	Installed	Feet	Year	Installed	Feet
1910	105	105	0					
1940	0	0	0					
TOTAL	105	105	0					

VALVES

4-IN. VALVES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	4	4	0
1923	3	3	0
1940	0	0	0
	—	—	—
TOTAL	7	7	0

6-IN. VALVES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	80	75	5
1912	1	1	0
1918	2	2	0
1920	1	1	0
1921	1	1	0
1925	3	3	0
1926	3	3	0
1927	24	24	0
1928	8	8	0
1929	33	33	0
1930	65	64	1
1931	7	7	0
1934	3	3	0
1935	1	1	0
1936	2	2	0
1937	7	7	0
1939	1	1	0
1940	2	2	0
	—	—	—
TOTAL	244	238	6

Retirements by Years

<i>Year</i>	<i>Number</i>		<i>Year</i>	<i>Number</i>	
<i>Installed</i>	<i>Number</i>		<i>Year</i>	<i>Number</i>	<i>Year</i>
1910	2		1929	3	1933
1930	1		1938		

8-IN. VALVES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	25	21	4
1912	3	3	0

8-IN. VALVES (contd.)

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1915	2	2	0
1921	1	1	0
1923	2	2	0
1927	2	2	0
1928	4	4	0
1929	2	2	0
1930	14	14	0
1934	1	1	0
1939	1	1	0
1940	0	0	0
	—	—	—
TOTAL	57	53	4

Retirements by Years

<i>Year</i>	<i>Number</i>	<i>Year</i>
<i>Installed</i>		
1910	4	1933

10-IN. VALVES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	1	1	0
1940	0	0	0
	—	—	—
TOTAL	1	1	0

12-IN. VALVES

<i>Year</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1910	10	10	0
1912	1	1	0
1916	1	1	0
1925	2	2	0
1927	1	1	0
1929	7	7	0
1930	15	15	0
1931	1	1	0
1940	0	0	0
	—	—	—
TOTAL	38	38	0

SURVIVAL AND RETIREMENT

16-IN. VALVES			
Year	Number		
Installed	Installed	In Service	Retired
1910	11	7	4
1913	3	3	0
1925	2	2	0
1929	13	13	0
1933	2	2	0
1936	1	1	0
1940	0	0	0
TOTAL	32	28	4

Retirements by Years				
Year	Number	Year	Number	Year
Installed				
1910	1	1913	3	1933

20-IN. VALVES			
Year	Number		
Installed	Installed	In Service	Retired
1910	26	26	0
1913	2	2	0
1929	3	3	0
1940	0	0	0
TOTAL	31	31	0

24-IN. VALVES			
Year	Number		
Installed	Installed	In Service	Retired
1910	2	2	0
1929	18	18	0
1931	1	1	0
1940	0	0	0
TOTAL	21	21	0

HYDRANTS

4-IN. HYDRANTS			
Year	Number		
Installed	Installed	In Service	Retired
1910	18	13	5
1912	1	1	0
1915	1	1	0
1917	1	1	0
1920	2	2	0
1921	3	3	0
1925	3	2	1
1926	3	3	0
1929	1	1	0
1932	1	1	0
1940	0	0	0
TOTAL	34	28	6

Retirements by Years					
Year	Num-	Year	Num-	Year	
Installed	ber	ber	ber	ber	
1910	1	1929	1	1930	1
	1	1935	1	1940	
1925	1	1936			

5-IN. HYDRANTS				
Year	Number			
Installed	Installed	In Service	Retired	
1927	3	3	0	
1929	1	1	0	
1930	180	177	3	
1931	1	0	1	
1932	1	1	0	
1934	12	12	0	
1935	4	4	0	
1936	5	5	0	
1937	5	5	0	
1939	5	5	0	
1940	2	2	0	
TOTAL	219	215	4	

Retirements by Years				
Year	Number	Year	Number	Year
Installed				
1930	1	1939	2	1940
1931	1	1937		

Utica, New York

As of December 31, 1940

THE Utica Board of Water Supply is in charge of the operation of the municipally-owned water system serving the city of Utica and contiguous area. The city is an important trading and industrial center located in the central part of the state on the banks of the Mohawk River. In addition to large textile mills the principal industries include the manufacture of metal and wood products, heating and ventilating equipment, clothing and fire arms. The State Barge Canal parallels the Mohawk River through the city.

The population of the city, as of the federal census of 1940, was 100,518. The water system serves a considerable area of surrounding territory, including the communities of Whitesboro, New Hartford, Oriskany, New York Mills, Yorkville, Frankfort and Deerfield and the towns of Marcy, Trenton and Schuyler. The population served at the date of the study was estimated to be 120,000. The consumption during 1940 averaged 12.8 mgd. or about 100 gpd. per capita.

Development of the Existing System

The forerunner of the present water system in Utica was created as the Utica Aqueduct Company by an act of the state legislature in April 1802. The supply was obtained from springs within the present city and conveyed through a log aqueduct to a central point. This aqueduct continued to supply part of the inhabitants until 1824

when it was severed and the supply cut off by the construction of the Erie Canal. From 1824 to 1834 local springs and wells were the only sources of water. In 1832 the Utica Water Works Association was formed, and, in 1834, the association laid a line of 2½-in. pipe from springs to the central part of the city. This served water to a part of the city until 1850 when it was abandoned.

In 1845 the Utica Water Works Company was formed. In 1849 contracts were let for the construction of a complete water works system. A supply was secured from a well at Starch Factory Creek and was conveyed through a 12-in. brick conduit, about 9,000 ft. long, to a reservoir in the city. Transmission from the reservoir was through a 12-, 8- and 6-in. cast-iron main branching into a number of 3- to 5-in. distribution mains. These works were completed and placed in operation in 1849. While the supply works, brick conduit and reservoir have been retired, many of the distribution mains, hydrants and valves are still in service.

In 1854, the 800,000-gpd. consumption from the spring was found inadequate and the present No. 1 Reservoir was constructed. Other impounding and distribution reservoirs were constructed from time to time, three of which have been retired over the years.

In 1938 the Consolidated Water Company, successor to the Utica Water Works Company, in existence for 89

Distribution Storage Facilities of Northern Supply System

<i>Name</i>	<i>Supplied From</i>	<i>Supplies</i>
Marcy Equalizing Standpipe	Hinckley	Reservoir Nos. 6 and 11
No. 11 Marcy Distributing	Hinckley	Intermediate and low service
No. 6 Bacot Distributing }	Hinckley and Reels	Low service
No. 7 Bacot Forebay }	Creek	
South Hill Standpipe	Reservoir Nos. 6 and 7	Turnbull Heights
No. 10 Whites Town Distributing	Intermediate service	Whitesboro low service
Whitesboro Equalizing Standpipe	Low service	Whitesboro low service
Old Oriskany Standpipe	Low service	Oriskany low service
New Oriskany Standpipe	Low service	Oriskany low service

years, was purchased by the city. The present supply is by gravity from impounding reservoirs grouped in two main systems on opposite sides north and south of the city. Distribution is in three services, the low service, which embraces the major portion and the congested section of the city, and the relatively minor intermediate and high services.

The northern or West Canada Creek supply system, developed since 1905, consists essentially of the Hinckley Reservoir on West Canada Creek and the Tracy Reservoir on Black Creek. The Hinckley Reservoir, 18 mi. northeast of the city, was constructed by the state in 1916 to serve chiefly as a feeder for the State Barge Canal. The city has the right to take 50 mgd. from this reservoir. The Tracy Reservoir, constructed in 1906-1907, 10 mi. southeast of the Hinckley Reservoir, provides reserve storage to

compensate for the supply taken from the Hinckley Reservoir when the flow of West Canada Creek is reduced to below the necessary requirements. Another small source in this system is the Reels Creek intake which diverts water from a small stream into two distributing reservoirs during a part of the year.

The southern supply system consists mainly of the Graefenberg Reservoir and Savage intake. The Graefenberg Reservoir, known as Reservoir No. 1, located about 2 mi. southeast of the city, was originally built in 1854 and raised in 1864-1865. It serves the high-service area on the south side of the territory with water secured from a small drainage area and wells. The Savage intake diverts water from natural drainage and springs and furnishes the supply to Reservoir Nos. 2, 4 and 5, the latter two of which also receive some natural drainage.

Distribution Storage Facilities of Southern Supply System

<i>Name</i>	<i>Supplied From</i>	<i>Supplies</i>
No. 2 Hopper Settled Storage	Reservoir Nos. 3, 4 and 5	Pumped to high or low service
No. 4 Golden Distributing	Natural drainage and Reservoir No. 3	Low service and Reservoir Nos. 2 and 5
No. 5 Cascade Settled Storage	Natural drainage and Reservoir Nos. 3 and 4	Pumped to high or low service
No. 8 New Hartford Equalizer	Reservoir Nos. 1 and 11	Intermediate service and pumped to high service
New Hartford Tanks	Reservoir No. 1 or pumped from No. 8	New Hartford high service

Except in certain emergencies, or at times of low flows in the supply streams, the entire service is by gravity. At the Hinckley Reservoir there is located a 13-mgd. motor-driven booster pump used when the reservoir is considerably drawn down for Barge Canal use. At Reservoir No. 2 is a booster station in which are located two 5-mgd. and one 1-mgd. pumps, the first two of which pump from Reservoir Nos. 2 or 5 into Reservoir No. 4 or to low service or by operation in series into the high service. The 1-mgd. pump discharges into the high-service area.

From the terminus of a state-owned 42-in. pipe below Hinckley a 24-in. cast-iron line extends about 12 mi. to the Marcy standpipe, thence another 2 mi. to the Marcy Reservoir (distributing) and continuing about 2 mi. farther to the southwestern intermediate service. From the Marcy standpipe a 16-in. line extends 2.2 mi. to a connection with the 24-in. intermediate-service line and continues easterly as parallel 16- and 24-in. lines 2.5 mi. to the Bacot-Deerfield Reservoir Nos. 6 and 7. Reels Creek is connected to these reservoirs through a 20-in. main 1.5 mi. long. From these distributing reservoirs, Nos. 6 and 7, located a little over a mile outside the city limits, parallel 20- and 30-in. mains

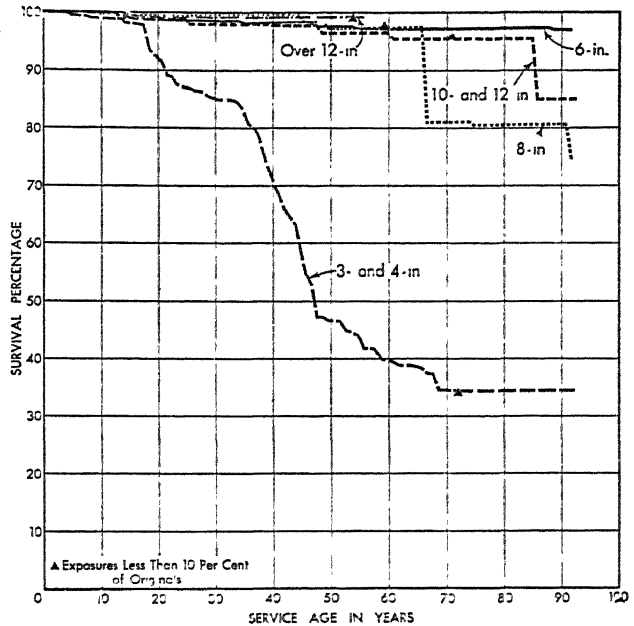


FIG. 1. Mortality Survival Curve—3-42-in. Cast-Iron Unlined Mains—Utica, New York

BASE: Feet		SURVIVAL: 1849-1940	
SIZE		EXPOSURES	RETIREMENTS
in.		ft.	ft.
3 and 4		90,597	55,257
6		596,806	10,972
8		135,949	3,175
10 and 12		131,384	3,246
Over 12		205,064	1,557

extend southerly into the city's congested area.

From the southern system a 12-in. main from No. 1, Graefenberg Reservoir, extends 1.2 mi. north to the high-service area. A 20-in. main extends 1.5 mi. from Savage intake to Reservoir No. 4 at the southerly city limits.

In the congested portion of the low-service area the pressures normally range from 60 to 80 psi. In the intermediate- and high-service areas the pressures range from 100 to 120 psi. The weights of the pipe in the supply

mains vary from Class C to 250-lb. centrifugal cast-iron pipe. Prior to about 1927 the distribution pipe laid consisted of Class B (since the adoption of such standard), and since 1927

150-lb. cement-lined cast-iron pipe has been standard. Pipes are laid with a cover of from 4 to 4½ ft. Unlined pipe shows a moderate amount of tuberculation.

TABLE 1
SUMMARY OF MAINS
UTICA, NEW YORK

Size, in.	Kind	No. of Feet Installed	Percentage of Total	No. of Feet Retired	Percentage of Total	No. of Feet in Service	Percentage of Total	Year of First Installation	Average Age, yr.
3	Cast-iron unlined	27,552	2.34	22,632	28.31	4,920	0.46	1849	66.9
4		63,045	5.36	32,625	40.81	30,420	2.78	1849	62.9
6		596,806	50.77	10,972	13.73	585,834	53.46	1849	37.7
8		135,949	11.57	3,175	3.97	132,774	12.12	1849	38.6
10		37,773	3.22	2,399	3.00	35,374	3.24	1849	50.3
12		93,611	7.96	847	1.06	92,764	8.47	1849	28.3
16		31,979	2.72	0	0	31,979	2.92	1886	36.1
20		54,776	4.66	1,371	1.71	53,405	4.88	1885	41.2
24		112,694	9.59	186	0.24	112,508	10.27	1885	31.8
30		5,615	0.48	0	0	5,615	0.51	1924	16.5
42	Cast-iron cement lined	900	0.08	0	0	900	0.08	1912	28.5
6		5,069	0.43	0	0	5,069	0.46	1934	5.6
8		26	0.00	0	0	26	0.00	1938	2.5
12		1,216	0.10	0	0	1,216	0.11	1934	6.0
21		128	0.01	0	0	128	0.01	1934	6.5
30		500	0.04	0	0	500	0.04	1913	27.5
36		28	0.00	0	0	28	0.00	1913	27.5
48		148	0.01	0	0	148	0.01	1898	41.8
60		63	0.01	0	0	63	0.01	1913	27.5
72		442	0.04	409	0.51	33	0.00	1891	49.5
1	Wrought-iron	1,210	0.10	1,210	1.51	0	0.00	1860	
2		1,702	0.14	1,239	1.55	463	0.04	1851	29.4
2½		2,877	0.24	2,877	3.60	0	0.00	1902	
3		31	0.00	0	0	31	0.00	1935	5.5
1	Copper	226	0.02	0	0	226	0.02	1935	5.5
1½		158	0.01	0	0	158	0.01	1935	5.5
2		4	0.00	0	0	4	0.00	1938	2.5
1	Galvanized steel lead-lined								
		98	0.01	0	0	98	0.01	1913	27.5
2		128	0.01	0	0	128	0.01	1913	27.5
6	Steel, bituminous lined and coated								
		470	0.04	0	0	470	0.04	1940	0.5
8		45	0.00	0	0	45	0.00	1937	3.5
30	Ingot-iron	500	0.04	0	0	500	0.04	1913	27.5
TOTAL		1,175,769	100.00	79,942	100.00	1,095,827	100.00		53.11
Percentage of Total		100.0		6.80		93.2			
Average Size, in.		9.46		4.60		9.81			

TABLE 1 (contd.)
Mortality Survival Ratios
Cast-Iron Unlined Pipe

Size, in.	No of Feet	Period Covered, yr.	Percentage
3 and 4	90,597	91.5	33.902
6	596,806	91.5	89.945
8	135,949	91.5	74.214
10 and 12	131,384	91.5	84.752
Over 12	205,064	55.5	99.222
Total	1,159,800		

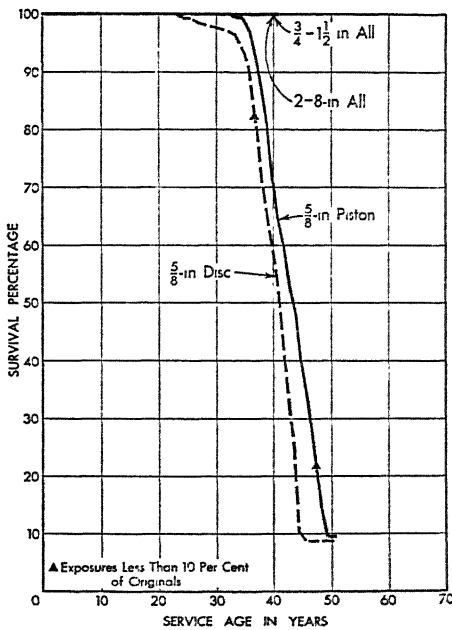


FIG. 2. Mortality Survival Curve— $\frac{5}{8}$ -in. Meters—Utica, New York

BASE: Unit SURVIVAL: 1890-1940

SIZE in.	KIND	EXPO- SURES Units	RETIRE- MENTS Units
$\frac{5}{8}$	Disc	18,219	1,055
$\frac{5}{8}$	Piston	2,660	1,378
$\frac{3}{4}$ - $1\frac{1}{2}$	All	776	0
2-8	All	377	0

As of the date of this study there were in the system 25,575 service connections, 3,874 valves, 1,884 hydrants and 21,622 meters. Active services were approximately 100 per cent metered with 80 per cent of the total water served being accounted for through the distribution meters.

Basis of Study

The records of installation and retirement of pipe within the city, with minor exceptions, are complete from 1849 to date and are kept in a main record book. Other record books of the early history and for the periods 1874-1888 and 1888 and 1902 are available for checks. The main supply lines are included in the studies of pipe but not the minor amount of distribution pipe outside the city limits.

The records of installation and retirement of valves have not been accurately kept up to date, so no study of these was initiated.

The records of meters are substantially complete from 1891 to date and are kept in card index form. Retired meter cards are retained in a separate file. From about 1882, when meters were first installed, through 1890 the records are not complete.

TABLE 2
SUMMARY OF METERS
UTICA, NEW YORK

Size, in.	Kind	Number Installed	Number Retired	Number in Service	Average Age, yr.
$\frac{5}{8}$	Disc	18,219	1,055	17,164	23.3
$\frac{3}{4}$		422	0	422	26.6
1		237	0	237	23.5
$1\frac{1}{2}$		19	0	19	24.1
2		56	0	56	24.2
$1\frac{1}{2}$		51	0	51	20.1
2	Compound	112	0	112	21.0
3		35	0	35	22.0
4		48	0	48	20.9
6		28	0	28	15.6
8		8	0	8	14.4
3		Crest	4	0	4
4	Crest	5	0	5	34.9
3	Current	4	0	4	36.5
4		2	0	2	31.0
6		1	0	1	34.5
6	Detector	3	0	3	17.8
$\frac{3}{8}$	Piston	2,660	1,378	1,282	30.2
3	Piston	2	0	2	42.0
4	Protectus	5	0	5	20.7
6		36	0	36	20.3
8		24	0	24	20.3
4×1		8	0	8	18.0
6×1	Valve	2	0	2	22.0
$6 \times 1\frac{1}{2}$		37	0	37	12.1
6×2		4	0	4	20.0
TOTAL		22,032	2,433	19,599	23.8

Mortality Survival Ratios

Size, in.	Kind	Period Covered, yr.	Percentage
$\frac{5}{8}$	Disc	50.5	8.984
$\frac{3}{8}$	Piston	50.5	9.732
$\frac{1}{2}$ -1	All	43.5	100.000
2-8	All	43.5	100.000

TABLE 3
SUMMARY OF HYDRANTS
UTICA, NEW YORK

Size, in.	Kind	Number Installed	Number Retired	Number in Service	Average Age, yr.	Period Covered, yr.	Mortality Survival Ratio, %
3-10	All	1,726	150	1,576	28.5	91.5	42.510

The records of hydrant installation and retirement are quite complete in card index form from 1849 to the present. Prior to about 1870 there were some discrepancies in retirements and between that date and 1910, some shifting of hydrants from one location to another. Since 1910 the record is definite and complete.

The installation and retirement of Class B facilities from 1849 to date are quite definite as to size, age, general detail and retirement of those taken out of service.

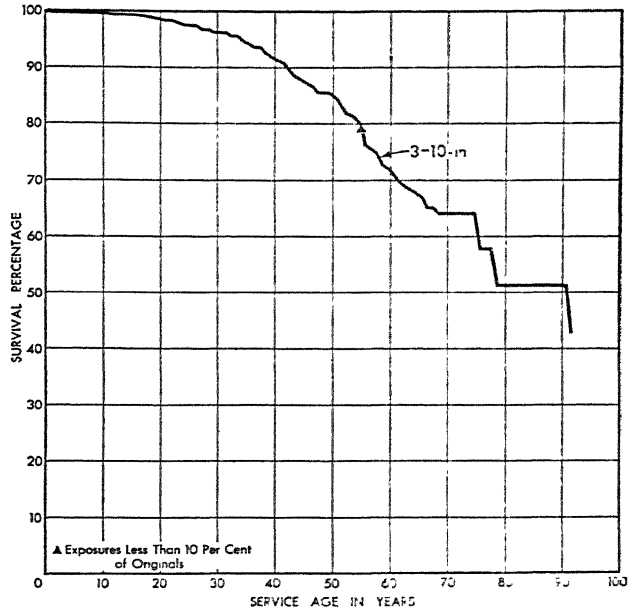


FIG. 3. Mortality Survival Curve—3-10-in. Hydrants—Utica, New York

Mortality Survival Study

Mortality studies were made of mains, meters and hydrants. Table 1 gives a summary of the pipe installed and retired and the amount remaining in service, as well as the average age, size, length of record and grouped mortality survival ratios. Figure 1 shows the mortality survival curves covering the record of the pipe grouped as shown.

Tables 2 and 3 are similar summaries of meters and hydrants, with Figs. 2 and 3 representing the applicable mortality survival curves.

Given below is a brief summary of Class B facilities, with the exception of pumping equipment which is minor in character, from 1849 to the present time, with the reasons for retirement for those facilities which have been retired.

BASE: Unit		SURVIVAL: 1849-1940	
SIZE	EXPOSURES	RETIREMENTS	
in.	Units	Units	
3-10	1,726	150	

Causes of Retirement

With minor exceptions records were not kept of, nor was it possible to determine, the causes of retirement of mains, meters and hydrants. Neither was it determinable whether such facilities were abandoned or whether there was salvage and re-use of certain units.

Acknowledgments

The collection and compilation of the data in Utica were done by and under the direction of J. Walter Ackerman, a member of the Committee on Survival and Retirement Experience With Water Works Facilities, with the co-operation of the Utica Board of Water Supply of which H. B. Miles is General Manager.

SUMMARY OF CLASS B FACILITIES

UTICA, NEW YORK

Impounding Reservoirs

Tracy Reservoir—Ambursen concrete dam on Black Creek, approximately 345 ft. long, impounding 1,200 mil.gal. from a watershed area of 25.3 sq mi. Constructed in 1906-1907 and still in service.

Hinckley Reservoir—Constructed by the state for State Barge Canal regulation, from which the city has the right to draw 50 mgd., provided the storage available in Tracy Reservoir is used for compensation to provide a certain minimum amount for the Barge Canal. Reservoir of 25,000-mil.gal. capacity is formed by an earthen dam with concrete spillway on West Canada Creek; drainage area 400 sq.mi. Dam 3,700 ft. long with 400-ft. spillway; maximum height 93 ft. from bottom to top of core wall. Constructed in 1912 and still in service.

Distribution Reservoirs

No. 1—Graefenberg Reservoir—Earth embankment dam, 28-mil.gal. capacity; maximum depth 50 ft.; area about seven acres. Originally constructed in 1854, raised 6 ft. in 1864-1865 and still in service.

No. 2—Hopper Storage Reservoir—Earth embankment, puddled core wall; 36-mil.gal. capacity; area about 12.6 acres. Originally constructed in 1868, enlarged and deepened in 1886 and still in service.

No. 3—Earth embankment reservoir, 228-mil.gal. capacity, maximum depth 59 ft.; area about 26 acres. Constructed in 1873 and retired in 1902 because of failure of embankment.

No. 4—Golden Reservoir—Earth embankment reservoir, capacity 282 mil.gal.; puddled core wall; average depth 24 ft.; area 34 acres. Constructed in 1886, raised 10 ft. in 1896 and still in service.

No. 5—Cascade Reservoir—Earth embankment reservoir, capacity 187 mil.gal.; puddled core; average depth 24 ft.; area 23 acres. Constructed in 1896, reinforced in 1902, and still in service.

No. 6—Bacot Reservoir—Earth embankment reservoir, capacity 98 mil.gal.; puddled core; maximum depth 43 ft.; area 14 acres. Constructed in 1900, embankment reinforced in 1903, and still in service.

No. 7—Bacot Forebay—Earth embankment dam, capacity 6.5 mil.gal.; puddled core;

maximum depth 15 ft.; area 1.7 acres. Constructed in 1900, and still in service.

No. 8—New Hartford Reservoir—Earth embankment reservoir, capacity 1.5 mil.gal.; maximum depth 8 ft.; area 1.4 acres. Constructed in 1895 and still in service.

No. 9—Earth embankment reservoir, capacity 2.5 mil.gal.; maximum depth 10 ft.; area 1.2 acres. Constructed in 1895 and abandoned in 1925 due to diminishing supply and increasing pollution.

No. 10—Whites Town Reservoir—Earth embankment reservoir, capacity 3.5 mil.gal.; area 1.7 acres. Constructed in 1898; not in use but held in reserve.

No. 11—Marcy Reservoir—Earth embankment reservoir, capacity 15 mil.gal.; concrete cut-off wall; maximum depth 30 ft.; area 3.5 acres. Constructed in 1913, and still in service.

Original Reservoir—Unknown construction and size. Constructed in 1849 and abandoned in 1868 because of low pressure due to low elevation.

Elevated Tanks and Standpipes

Old Oriskany Standpipe—Open steel standpipe, 30 ft. in diameter, 50 ft. high; 250,000-gal. capacity. Constructed in 1916-1917 and still in service.

New Oriskany Standpipe—Open steel standpipe, 26 ft. in diameter, 50 ft. high; 200,000-gal. capacity. Constructed in 1934 and still in service.

Whites Town Standpipe—Open steel standpipe, 29 ft. in diameter, 49 ft. high; 250,000-gal. capacity. Constructed in 1935 and still in service.

New Hartford Elevated Tank—Covered steel elevated tank, hemispherical bottom; 32 ft. in diameter, 47 ft. deep, 99 ft. to flow line; 250,000-gal. capacity. Constructed in 1928 and still in service.

South Hill Standpipe—Covered steel standpipe, 48 ft. in diameter, 19 ft. high; 266,000-gal. capacity. Constructed in 1928 and still in service.

Old New Hartford Elevated Tank—Covered steel elevated tank, hemispherical bottom; 19 ft. in diameter, 17½ ft. deep; 50,000-gal. capacity. Constructed in 1916 and retired in 1928 because it was below required pressure and small size.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
UTICA, NEW YORK

MAINS

3-IN. CAST-IRON UNLINED MAINS

<i>Year</i> <i>Installed</i>	<i>Feet</i>			<i>Year</i> <i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1849	10,260	0	10,260	1869	5,934	2,519	3,415
1850	2,658	0	2,658	1871	900	900	0
1851	1,534	0	1,534	1872	390	0	390
1852	271	0	271	1875	406	36	370
1853	1,430	0	1,430	1886	100	0	100
1854	240	0	240	1888	135	135	0
1859	100	0	100	1889	195	195	0
1860	151	116	35	1894	379	379	0
1861	150	110	40	1896	170	170	0
1863	372	0	372	1898	12	0	12
1864	72	0	72	1901	70	70	0
1866	20	0	20	1910	0	0	0
1867	440	0	440				
1868	1,163	290	873	TOTAL	27,552	4,920	22,632

Retirements by Years

<i>Year</i> <i>Installed Feet</i>				<i>Year</i> <i>Feet</i>			
<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1849	410	1868	2,390	1887	275	1889	
	1,770	1890	240	1892	1,230	1893	
	900	1894	3,045	1896			
1850	115	1887	662	1889	350	1892	
	275	1893	491	1895	241	1897	
	222	1899	142	1910	160	1914	
1851	307	1887	175	1890	298	1894	
	188	1897	265	1905	301	1917	
1852	271	1889					
1853	200	1857	500	1871	140	1889	
	420	1892	170	1913			
1854	240	1893					
1859	100	1888					
1860	35	1890					
				1861	40	1929	
				1863	130	1907	122 1908 120 1929
				1864	72	1893	
				1866	20	1892	
				1867	440	1907	
				1868	150	1874	176 1888 139 1892
					108	1910	58 1913 242 1929
				1869	940	1887	460 1890 12 1907
					1,153	1914	642 1915 52 1919
					97	1929	34 1934 25 1938
				1872	390	1907	
				1875	370	1917	
				1886	100	1914	
				1898	12	1910	

4-IN. CAST-IRON UNLINED MAINS

<i>Year</i> <i>Installed</i>	<i>Feet</i>			<i>Year</i> <i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1849	6,250	1,564	4,686	1862	109	0	109
1850	3,605	0	3,605	1863	176	176	0
1853	3,612	1,688	1,924	1867	487	420	67
1858	368	287	81	1868	7,995	2,310	5,685
1860	490	240	250	1869	8,500	4,533	3,967

Feet				Feet			
Year	Installed	In Service	Retired	Year	Installed	In Service	Retired
1871	1,411	1,018	393	1894	526	437	89
1872	984	977	7	1895	58	58	0
1873	2,207	376	1,831	1896	171	171	0
1874	3,274	1,482	1,792	1897	444	420	24
1875	2,835	1,662	1,173	1899	16	0	16
1876	224	24	200	1900	32	32	0
1877	175	175	0	1901	25	25	0
1878	950	850	100	1904	130	130	0
1879	365	365	0	1906	22	22	0
1880	483	233	250	1908	535	535	0
1881	798	798	0	1910	522	522	0
1882	60	0	60	1912	41	41	0
1884	375	315	60	1914	11	0	11
1885	714	297	417	1915	350	350	0
1886	589	83	506	1926	156	156	0
1887	1,904	1,137	767	1928	23	13	10
1888	4,225	2,016	2,209	1930	16	16	0
1889	238	23	215	1934	20	20	0
1890	1,111	137	974	1940	0	0	0
1891	3,036	2,794	242				
1892	955	890	65				
1893	1,442	602	840				
				TOTAL	63,045	30,420	32,625

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1849	1,160	1893	375	1895	257	1898		1876	200	1910					
	1,195	1901	48	1907	65	1908		1878	100	1886					
	18	1910	42	1912	1,462	1917		1880	250	1894					
	64	1919						1882	60	1916					
1850	800	1887	175	1895	1,580	1905		1884	60	1899					
	1,050	1908						1885	264	1907	153	1913			
1853	1,000	1897	575	1899	50	1905		1886	382	1907	124	1915			
	100	1907	41	1912	100	1918		1887	315	1908	117	1909	25	1915	
	58	1919							310	1917					
1858	81	1907						1888	548	1908	12	1909	1,290	1911	
1860	250	1868							99	1913	260	1914			
1862	109	1907						1889	170	1908	35	1913	10	1915	
1867	67	1907						1890	32	1908	703	1909	94	1913	
1868	1,036	1886	560	1889	444	1896			95	1914	50	1915			
	605	1907	1,460	1908	1,580	1915		1891	76	1905	66	1907	100	1908	
1869	955	1887	165	1895	891	1904		1892	65	1908					
	380	1908	39	1911	1,070	1913		1893	505	1907	335	1911			
	339	1914	128	1922				1894	41	1913	38	1915	10	1929	
1871	245	1907	148	1913				1897	24	1908					
1872	7	1913						1899	16	1912					
1873	200	1894	570	1907	1,061	1908		1914	11	1915					
1874	340	1907	740	1912	712	1916		1928	10	1930					
1875	308	1912	27	1914	838	1916									

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1849	4,780	3,299	1,481	1905	11,772	11,772	0
1853	1,790	1,790	0	1906	8,349	8,166	183
1860	37	37	0	1907	6,348	6,348	0
1868	16,017	14,435	1,582	1908	6,958	6,958	0
1869	7,642	7,642	0	1909	1,711	1,711	0
1870	3,805	3,805	0	1910	5,932	5,850	82
1871	8,540	8,540	0	1911	11,155	11,155	0
1873	2,407	2,112	295	1912	5,685	5,425	260
1874	14,606	14,606	0	1913	7,985	7,581	404
1875	362	350	12	1914	16,039	16,039	0
1878	49	36	13	1915	8,997	8,997	0
1879	1,200	1,200	0	1916	8,353	8,353	0
1880	973	973	0	1917	4,162	3,910	252
1881	961	941	20	1918	722	722	0
1882	47	47	0	1919	13,292	13,292	0
1884	320	320	0	1920	1,629	1,629	0
1885	6,133	6,105	28	1921	23,683	23,558	125
1886	22,024	21,927	97	1922	25,827	25,817	10
1887	16,956	16,916	40	1923	28,249	27,376	873
1888	25,122	25,086	36	1924	12,691	12,691	0
1889	19,351	19,111	240	1925	13,884	13,884	0
1890	19,655	19,556	99	1926	7,200	6,988	212
1891	16,595	16,595	0	1927	17,000	16,458	542
1892	14,988	14,988	0	1928	7,763	7,723	40
1893	15,282	13,598	1,684	1929	7,453	7,371	82
1894	13,721	13,142	579	1930	7,122	7,122	0
1895	15,592	14,948	644	1931	6,193	6,183	10
1896	6,083	5,813	270	1932	1,622	1,614	8
1897	11,674	11,654	20	1933	1,355	1,355	0
1898	7,409	7,409	0	1934	483	483	0
1899	7,598	7,382	216	1935	162	162	0
1900	7,263	7,263	0	1937	55	55	0
1901	7,840	7,344	496	1938	18	18	0
1902	6,766	6,766	0	1940	0	0	0
1903	4,195	4,195	0				
1904	9,174	9,137	37				
				TOTAL	596,806	585,834	10,972

Retirements by Years

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1849	1,115	1896	105	1912	261	1937			1893	1,684	1908				
1868	1,020	1870	342	1915	220	1922			1894	579	1908				
1873	295	1908							1895	128	1913	84	1916	432	1923
1875	12	1908							1896	270	1910				
1878	13	1908							1897	20	1911				
1881	20	1913							1899	216	1931				
1885	28	1908							1901	496	1935				
1886	48	1912	49	1913					1904	37	1929				
1887	40	1912							1906	183	1935				
1888	14	1911	22	1913					1910	60	1929	22	1937		
1889	62	1913	70	1923	108	1937			1912	260	1924				
1890	75	1908	24	1913					1913	404	1931				

SURVIVAL AND RETIREMENT

6-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

Year				Year			
Installed	Feet	Year	Feet	Year	Installed	Feet	Year
1917	252	1934			1927	542	1934
1921	15	1934	110	1938	1928	10	1930
1922	10	1933			1929	16	1934
1923	870	1934	3	1939	1931	10	1940
1926	212	1934			1932	8	1939

8-IN. CAST-IRON UNLINED MAINS

Year				Year			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1849	3,060	1,578	1,482	1910	623	623	0
1868	1,813	1,337	476	1911	2,881	2,881	0
1874	2,560	2,560	0	1912	3,223	3,223	0
1875	4,073	4,051	22	1913	7,835	7,561	274
1878	1,680	1,680	0	1914	3,313	3,313	0
1881	1,841	1,841	0	1915	2,160	2,160	0
1882	5,910	5,513	397	1916	2,106	2,106	0
1885	190	190	0	1917	4,845	4,845	0
1886	7,421	7,392	29	1919	391	391	0
1887	12,063	12,063	0	1920	206	206	0
1888	3,225	3,199	26	1921	24	24	0
1889	2,902	2,902	0	1922	1,279	1,279	0
1891	15	15	0	1923	6,844	6,832	12
1892	1,721	1,721	0	1924	4,660	4,660	0
1893	4,697	4,697	0	1925	2,438	2,438	0
1894	1,572	1,572	0	1926	2,707	2,250	457
1895	1,692	1,692	0	1927	1,391	1,391	0
1896	3,782	3,782	0	1929	2,889	2,889	0
1897	1,240	1,240	0	1930	67	67	0
1898	1,981	1,981	0	1931	1,653	1,653	0
1900	1,227	1,227	0	1932	603	603	0
1901	620	620	0	1933	550	550	0
1903	1,268	1,268	0	1934	102	102	0
1904	2,047	2,047	0	1938	22	22	0
1905	1,024	1,024	0	1939	117	117	0
1906	1,908	1,908	0	1940	0	0	0
1907	7,311	7,311	0				
1908	3,855	3,855	0	TOTAL	135,949	132,774	3,175
1909	322	322	0				

Retirements by Years

Year				Year			
Installed	Feet	Year	Feet	Year	Installed	Feet	Year
1849	200	1894	1,141	1915	1886	29	1935
	126	1940			1888	26	1931
1868	476	1913			1913	274	1925
1875	22	1908			1923	12	1940
1882	397	1931			1926	457	1934

10-IN. CAST-IRON UNLINED MAINS

<i>Year</i> <i>Installed</i>	<i>Feet</i>			<i>Year</i> <i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1849	4,630	4,050	580	1912	627	627	0
1868	3,050	3,050	0	1913	38	38	0
1869	1,020	535	485	1915	31	31	0
1880	2,080	2,080	0	1916	1,021	1,021	0
1885	2,425	2,425	0	1940	23	23	0
1887	1,845	1,845	0				
1892	2,996	2,055	941	TOTAL	37,773	35,374	2,399
1894	485	485	0				
1900	3,802	3,802	0	<i>Retirements by Years</i>			
1901	1,790	1,790	0	<i>Year</i>			
1905	8,050	7,867	183	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1907	949	949	0	1849	580	1934	
1908	2,238	2,028	210	1869	485	1894	
1909	8	8	0	1892	841	1905	100
1910	324	324	0	1905	183	1916	1916
1911	341	341	0	1908	210	1915	

12-IN. CAST-IRON UNLINED MAINS

<i>Year</i> <i>Installed</i>	<i>Feet</i>			<i>Year</i> <i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1849	300	300	0	1923	2,213	2,213	0
1853	300	300	0	1924	2,980	2,980	0
1868	3,130	2,394	736	1925	1,825	1,825	0
1870	5,522	5,411	111	1926	3,363	3,363	0
1871	3,402	3,402	0	1927	6,814	6,814	0
1886	2,325	2,325	0	1928	11,283	11,283	0
1887	500	500	0	1929	1,347	1,347	0
1891	23	23	0	1930	56	56	0
1897	500	500	0	1931	230	230	0
1900	5,011	5,011	0	1932	207	207	0
1905	2,671	2,671	0	1933	529	529	0
1906	5,833	5,833	0	1934	896	896	0
1907	75	75	0	1935	44	44	0
1908	9,868	9,868	0	1938	7,361	7,361	0
1909	797	797	0	1940	934	934	0
1913	2,721	2,721	0				
1914	297	297	0	TOTAL	93,611	92,764	847
1915	2,582	2,582	0				
1916	1,087	1,087	0	<i>Retirements by Years</i>			
1917	1,066	1,066	0	<i>Year</i>			
1918	259	259	0	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1919	99	99	0	1868	442	1916	294
1921	5,161	5,161	0	1870	111	1909	

16-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1886	795	795	0
1898	854	854	0
1901	412	412	0
1904	22,766	22,766	0
1905	1,954	1,954	0
1906	27	27	0
1907	53	53	0
1908	3,512	3,512	0
1909	155	155	0
1913	1,133	1,133	0
1921	38	38	0
1929	280	280	0
1940	0	0	0
TOTAL	31,979	31,979	0

20-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	6,541	6,541	0
1886	8,438	8,438	0
1900	16,704	15,586	1,118
1905	215	0	215
1907	19,977	19,977	0
1913	1,937	1,937	0
1915	651	651	0
1916	253	215	38
1921	27	27	0
1924	33	33	0
1940	0	0	0
TOTAL	54,776	53,405	1,371

Retirements by Years

Year			Year		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1900	193	1905	404	1913	355
	166	1916			
1905	215	1916			
1916	38	1918			

24-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	6,924	6,814	110
1906	62,845	62,845	0

24-IN. CAST-IRON UNLINED MAINS (contd.)

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	596	596	0
1913	28,555	28,479	76
1915	266	266	0
1916	70	70	0
1921	54	54	0
1924	13,384	13,384	0
1940	0	0	0
TOTAL	112,694	112,508	186

Retirements by Years

Year			Year		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1885	110	1916			
1913	76	1921			

30-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1924	5,615	5,615	0
1940	0	0	0
TOTAL	5,615	5,615	0

6-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1934	1,877	1,877	0
1935	443	443	0
1936	1,750	1,750	0
1937	1,332	1,332	0
1938	40	40	0
1939	586	586	0
1940	41	41	0
TOTAL	5,069	5,069	0

8-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	26	26	0
1940	0	0	0
TOTAL	26	26	0

12-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1934	651	651	0
1935	565	565	0
1940	0	0	0
TOTAL	1,216	1,216	0

21-IN. STEEL MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1934	128	128	0
1940	0	0	0
TOTAL	128	128	0

$\frac{5}{8}$ -IN. LEAD MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1913	28	28	0
1940	0	0	0
TOTAL	28	28	0

$\frac{3}{4}$ -IN. LEAD MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1898	45	45	0
1899	103	103	0
1940	0	0	0
TOTAL	148	148	0

$\frac{1}{4}$ -IN. WROUGHT-IRON MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1913	63	63	0
1940	0	0	0
TOTAL	63	63	0

1-IN. WROUGHT-IRON MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1891	33	33	0
1909	138	0	138
1919	150	0	150
1923	65	0	65

1-IN. WROUGHT-IRON MAINS (contd.)

Year	Feet		
Installed	Installed	In Service	Retired
1924	56	0	56
1940	0	0	0
TOTAL	442	33	409

Retirements by Years

Year	Feet	Year	Feet
1909	138	1915	
1919	150	1932	
1923	65	1932	
1924	56	1932	

1 $\frac{1}{2}$ -IN. WROUGHT-IRON MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1860	126	0	126
1902	235	0	235
1908	849	0	849
1940	0	0	0
TOTAL	1,210	0	1,210

Retirements by Years

Year	Feet	Year	Feet	Year
1860	126	1899		
1902	235	1902		
1908	424	1917	425	1921

2-IN. WROUGHT-IRON MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1851	175	0	175
1908	1,064	0	1,064
1910	433	433	0
1926	10	10	0
1928	20	20	0
1940	0	0	0
SUBTOTAL	1,702	463	1,239
Unknown	54	0	54
TOTAL	1,756	463	1,293

Retirements by Years

Year	Feet	Year	Feet
1851	175	1890	
1908	1,064	1917	

2½-IN. WROUGHT-IRON MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1902	2,863	0	2,863
1909	14	0	14
1940	0	0	0
TOTAL	2,877	0	2,877

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1902	2,863	1917
1909	14	1917

¾-IN. COPPER MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1935	31	31	0
1940	0	0	0
TOTAL	31	31	0

1-IN. COPPER MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1935	226	226	0
1940	0	0	0
TOTAL	226	226	0

1½-IN. COPPER MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1935	158	158	0
1940	0	0	0
TOTAL	158	158	0

2-IN. COPPER MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	4	4	0
1940	0	0	0
TOTAL	4	4	0

1-IN. GALVANIZED STEEL LEAD-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1913	98	98	0
1940	0	0	0
TOTAL	98	98	0

2-IN. GALVANIZED STEEL LEAD-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1913	128	128	0
1940	0	0	0
TOTAL	128	128	0

6-IN. STEEL BITUMINOUS-LINED
AND COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1940	470	470	0
TOTAL	470	470	0

8-IN. STEEL BITUMINOUS-LINED
AND COATED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1937	45	45	0
1940	0	0	0
TOTAL	45	45	0

METERS

$\frac{5}{8}$ -IN. DISC METERS

Year				Year			
Installed	Number			Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1890	1	1	0	1918	439	439	0
1891	1	0	1	1919	411	411	0
1895	6	5	1	1920	505	505	0
1896	105	13	92	1921	522	521	1
1897	134	46	88	1922	755	754	1
1898	184	70	114	1923	1,307	1,306	1
1899	195	125	70	1924	1,073	1,073	0
1900	26	13	13	1925	748	748	0
1901	34	22	12	1926	1,307	1,307	0
1902	391	143	248	1927	222	222	0
1903	369	125	244	1928	186	186	0
1904	708	702	6	1929	20	20	0
1905	540	538	2	1930	139	139	0
1906	761	760	1	1931	159	159	0
1907	536	535	1	1932	66	66	0
1908	411	410	1	1933	2	2	0
1909	614	614	0	1934	193	193	0
1910	758	722	36	1936	23	22	1
1911	482	460	22	1937	133	133	0
1912	414	391	23	1938	139	139	0
1913	661	587	74	1939	169	169	0
1914	659	658	1	1940	65	65	0*
1915	540	540	0				
1916	571	571	0	TOTAL	18,219	17,164	1,055
1917	535	534	1				

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1891	1	1935					1903	1	1928	2	1929	2	1930
1895	1	1937						6	1931	4	1933	15	1934
1896	1	1928	5	1934	1	1935		7	1935	9	1936	57	1937
	5	1936	13	1937	7	1938		20	1938	80	1939	41	1940
	36	1939	24	1940			1904	1	1938	5	1939		
1897	1	1929	1	1930	1	1931	1905	1	1929	1	1937		
	1	1932	1	1933	1	1934	1906	1	1934				
	1	1935	5	1936	22	1937	1907	1	1940				
	10	1938	25	1939	19	1940	1908	1	1938				
1898	1	1930	2	1931	2	1933	1910	1	1931	2	1934	1	1935
	3	1934	4	1936	28	1937		2	1936	12	1937	1	1938
	16	1938	37	1939	21	1940		10	1939	7	1940		
1899	1	1931	9	1934	1	1935	1911	1	1934	2	1936	5	1937
	2	1936	16	1937	10	1938		3	1938	7	1939	4	1940
	19	1939	12	1940			1912	1	1934	9	1937	1	1938
1900	1	1934	1	1936	2	1937		9	1939	3	1940		
	2	1938	6	1939	1	1940	1913	1	1934	2	1936	22	1937
1901	1	1934	1	1936	1	1937		6	1938	30	1939	13	1940
	3	1938	3	1939	3	1940	1914	1	1937				
1902	2	1928	2	1929	2	1931	1917	1	1932				
	2	1932	9	1934	3	1935	1921	1	1940				
	8	1936	59	1937	32	1938	1922	1	1937				
	86	1939	43	1940			1923	1	1939				
							1936	1	1937				

¾-IN. DISC METERS

Year	Number			Year	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1903	3	3	0	1916	15	15	0
1904	20	20	0	1917	81	81	0
1905	8	8	0	1918	5	5	0
1906	53	53	0	1919	8	8	0
1907	5	5	0	1920	16	16	0
1908	27	27	0	1926	36	36	0
1909	14	14	0	1929	11	11	0
1912	45	45	0	1933	2	2	0
1913	44	44	0	1940	0	0	0
1914	24	24	0				
1915	5	5	0	TOTAL	422	422	0

1-IN. DISC METERS

Year	Number			Year	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1899	1	1	0	1918	23	23	0
1903	1	1	0	1923	12	12	0
1904	10	10	0	1924	7	7	0
1905	8	8	0	1925	7	7	0
1906	14	14	0	1926	15	15	0
1908	5	5	0	1927	12	12	0
1909	8	8	0	1929	12	12	0
1910	5	5	0	1930	8	8	0
1911	14	14	0	1931	7	7	0
1912	26	26	0	1933	4	4	0
1913	15	15	0	1940	0	0	0
1914	5	5	0				
1915	5	5	0	TOTAL	237	237	0
1916	13	13	0				

1½-IN. DISC METERS

Year	Number			Year	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1906	5	5	0	1928	1	1	0
1908	1	1	0	1929	1	1	0
1909	4	4	0	1940	0	0	0
1925	3	3	0				
1926	2	2	0	TOTAL	19	19	0
1927	2	2	0				

2-IN. DISC METERS

Year	Number			Year	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1906	7	7	0	1927	1	1	0
1907	5	5	0	1928	4	4	0
1908	12	12	0	1929	1	1	0
1909	6	6	0	1930	6	6	0
1910	2	2	0	1931	3	3	0
1924	1	1	0	1940	0	0	0
1925	6	6	0				
1926	2	2	0	TOTAL	56	56	0

1½-IN. COMPOUND METERS

Year Installed	Number		
	Installed	In Service	Retired
1912	1	1	0
1913	4	4	0
1914	3	3	0
1915	7	7	0
1916	3	3	0
1917	2	2	0
1918	3	3	0
1919	1	1	0
1921	2	2	0
1922	4	4	0
1923	4	4	0
1924	4	4	0
1925	4	4	0
1926	2	2	0
1927	1	1	0
1928	3	3	0
1929	2	2	0
1933	1	1	0
1940	0	0	0
TOTAL	51	51	0

2-IN. COMPOUND METERS

Year Installed	Number		
	Installed	In Service	Retired
1911	7	7	0
1912	14	14	0
1913	4	4	0
1914	3	3	0
1915	8	8	0
1916	7	7	0
1917	2	2	0
1918	4	4	0
1919	4	4	0
1920	1	1	0
1921	6	6	0
1922	8	8	0
1923	10	10	0
1924	10	10	0
1925	7	7	0
1926	8	8	0
1927	3	3	0
1928	2	2	0
1929	4	4	0
1940	0	0	0
TOTAL	112	112	0

3-IN. COMPOUND METERS

Year Installed	Number		
	Installed	In Service	Retired
1910	4	4	0
1911	2	2	0
1912	3	3	0
1913	2	2	0
1915	2	2	0
1916	6	6	0
1917	1	1	0
1918	1	1	0
1920	1	1	0
1921	1	1	0
1922	1	1	0
1923	5	5	0
1925	1	1	0
1926	1	1	0
1929	1	1	0
1932	1	1	0
1934	1	1	0
1940	1	1	0
TOTAL	35	35	0

4-IN. COMPOUND METERS

Year Installed	Number		
	Installed	In Service	Retired
1910	1	1	0
1911	1	1	0
1912	7	7	0
1913	6	6	0
1914	2	2	0
1916	3	3	0
1917	3	3	0
1918	1	1	0
1920	3	3	0
1921	1	1	0
1922	3	3	0
1923	2	2	0
1924	2	2	0
1925	3	3	0
1926	1	1	0
1928	3	3	0
1929	3	3	0
1930	1	1	0
1933	1	1	0
1937	1	1	0
1940	0	0	0
TOTAL	48	48	0

6-IN. COMPOUND METERS

Year	Number		
Installed	Installed	In Service	Retired
1916	1	1	0
1917	2	2	0
1918	4	4	0
1919	1	1	0
1920	1	1	0
1921	1	1	0
1922	1	1	0
1924	3	3	0
1925	2	2	0
1926	2	2	0
1927	2	2	0
1928	1	1	0
1929	1	1	0
1930	1	1	0
1932	1	1	0
1933	1	1	0
1937	1	1	0
1938	2	2	0
1940	0	0	0
TOTAL	28	28	0

8-IN. COMPOUND METERS

Year	Number		
Installed	Installed	In Service	Retired
1917	1	1	0
1926	4	4	0
1927	1	1	0
1928	1	1	0
1933	1	1	0
1940	0	0	0
TOTAL	8	8	0

3-IN. CREST METERS

Year	Number		
Installed	Installed	In Service	Retired
1906	2	2	0
1908	1	1	0
1909	1	1	0
1940	0	0	0
TOTAL	4	4	0

4-IN. CREST METERS

Year	Number		
Installed	Installed	In Service	Retired
1904	1	1	0
1906	4	4	0
1940	0	0	0
TOTAL	5	5	0

3-IN. CURRENT METERS

Year	Number		
Installed	Installed	In Service	Retired
1904	4	4	0
1940	0	0	0
TOTAL	4	4	0

4-IN. CURRENT METERS

Year	Number		
Installed	Installed	In Service	Retired
1906	1	1	0
1912	1	1	0
1940	0	0	0
TOTAL	2	2	0

6-IN. CURRENT METERS

Year	Number		
Installed	Installed	In Service	Retired
1906	1	1	0
1940	0	0	0
TOTAL	1	1	0

½-IN. PISTON METERS

Year	Number		
Installed	Installed	In Service	Retired
1890	1	1	0
1891	79	32	47
1892	123	42	81
1893	140	62	78
1894	156	57	99
1895	36	2	34
1896	278	105	173
1897	180	68	112
1898	107	41	66
1899	115	43	72
1900	347	138	209
1901	438	182	256
1902	90	40	50
1903	145	61	84
1904	22	5	17
1909	1	1	0
1919	1	1	0
1936	1	1	0
1937	317	317	0
1938	83	83	0
1940	0	0	0
TOTAL	2,660	1,282	1,378

$\frac{3}{8}$ -IN. PISTON METERS (contd.)

Retirements by Years

<i>Year Installed</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>	<i>Num- ber</i>	<i>Year</i>
1891	12	1937	7	1938	13	1939
	15	1940				
1892	1	1935	14	1937	8	1938
	23	1939	35	1940		
1893	1	1934	16	1937	14	1938
	19	1939	28	1940		
1894	18	1937	19	1938	24	1939
	38	1940				
1895	9	1937	6	1938	6	1939
	13	1940				
1896	1	1933	27	1937	40	1938
	35	1939	70	1940		
1897	1	1935	1	1936	27	1937
	16	1938	39	1939	28	1940
1898	13	1937	16	1938	15	1939
	22	1940				
1899	1	1936	19	1937	9	1938
	20	1939	23	1940		
1900	50	1937	48	1938	40	1939
	71	1940				
1901	60	1937	36	1938	51	1939
	109	1940				
1902	1	1935	7	1937	10	1938
	16	1939	16	1940		
1903	21	1937	14	1938	20	1939
	29	1940				
1904	4	1937	2	1938	6	1939
	5	1940				

3-IN. PISTON METERS

<i>Year Installed</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1897	1	1	0
1900	1	1	0
1940	0	0	0
TOTAL	2	2	0

4-IN. PROTECTUS METERS

<i>Year Installed</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1918	1	1	0
1919	2	2	0
1921	1	1	0
1922	1	1	0
1940	0	0	0
TOTAL	5	5	0

6-IN. PROTECTUS METERS

<i>Year Installed</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1916	1	1	0
1918	2	2	0
1919	17	17	0
1920	7	7	0
1921	1	1	0
1923	4	4	0
1924	2	2	0
1925	1	1	0
1926	1	1	0
1940	0	0	0
TOTAL	36	36	0

8-IN. PROTECTUS METERS

<i>Year Installed</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1919	15	15	0
1920	1	1	0
1922	5	5	0
1923	1	1	0
1924	2	2	0
1940	0	0	0
TOTAL	24	24	0

6-IN. DETECTOR METERS

<i>Year Installed</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1913	1	1	0
1924	1	1	0
1931	1	1	0
1940	0	0	0
TOTAL	3	3	0

4- \times 1-IN. VALVE METERS

<i>Year Installed</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1897	1	1	0
1912	1	1	0
1927	1	1	0
1928	1	1	0
1929	4	4	0
1940	0	0	0
TOTAL	8	8	0

6- × 1-IN. VALVE METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	1	1	0
1925	1	1	0
1940	0	0	0
	—	—	—
TOTAL	2	2	0

6- × 1½-IN. VALVE METERS (contd.)

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1932	2	2	0
1933	2	2	0
1940	0	0	0
	—	—	—
TOTAL	37	37	0

6- × 1½-IN. VALVE METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	3	3	0
1926	7	7	0
1927	4	4	0
1928	7	7	0
1929	5	5	0
1930	3	3	0
1931	4	4	0

6- × 2-IN. VALVE METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1908	1	1	0
1924	1	1	0
1925	2	2	0
1940	0	0	0
	—	—	—
TOTAL	4	4	0

HYDRANTS

3- TO 10-IN. HYDRANTS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1849	8	5	3
1853	2	2	0
1860	1	0	1
1868	10	7	3
1869	29	22	7
1870	7	4	3
1871	17	12	5
1873	5	3	2
1874	23	20	3
1875	7	7	0
1876	1	0	1
1877	1	0	1
1879	1	0	1
1881	8	6	2
1882	6	4	2
1884	1	1	0
1885	23	17	6
1886	50	45	5
1887	50	36	14
1888	34	23	11
1889	24	19	5
1890	20	18	2
1891	18	16	2
1892	17	12	5
1893	12	10	2
1894	8	7	1
1895	17	14	3
1896	21	15	6

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1897	34	29	5
1898	85	77	8
1899	52	47	5
1900	46	42	4
1901	30	27	3
1902	25	23	2
1903	17	17	0
1904	27	27	0
1905	37	35	2
1906	15	14	1
1907	73	62	11
1908	43	39	4
1909	4	4	0
1910	13	13	0
1911	19	18	1
1912	16	14	2
1913	37	35	2
1914	38	37	1
1915	31	30	1
1916	22	22	0
1917	17	17	0
1918	7	6	1
1919	29	29	0
1920	10	10	0
1921	54	54	0
1922	68	68	0
1923	77	77	0
1924	58	58	0

West Palm Beach, Florida

As of December 31, 1940

PALM BEACH and West Palm Beach, Fla., are supplied with water by the privately owned and operated plant of the West Palm Beach Water Company. The two communities are located on the Atlantic shore of Florida, separated by Lake Worth, an arm of the ocean about $\frac{1}{2}$ mi. wide. West Palm Beach has a permanent population of about 40,000 which is increased to about 50,000 during the winter months. It is predominantly a residential city but there are a number of small industries and it is the commercial and shipping center for the surrounding agricultural area. Palm Beach, located on the ocean, is a typical resort community, with a summer population of 5,000 and a winter population of about 20,000. The total population served ranges from 45,000 in the summer months to some 70,000 in the winter season.

As of the date of the study about 8,400 customers were attached to the distribution system, which consists of about 200 mi. of main and 822 fire hydrants.

Development of the Existing System

The initial water supply installation was made in 1894 by the Florida East Coast Hotel Company to supply water to the newly built Royal Poinciana Hotel in Palm Beach. The installation consisted of a pump on the shore of

Clear Lake, a fresh water lake located about a mile west of Lake Worth and an 8-in. transmission main to Palm Beach. The water supplied was untreated, very soft, rather highly corrosive and contained considerable organic color.

Later, the area between Clear Lake and Lake Worth was subdivided and became West Palm Beach. The resulting settlement was served from the hotel company's supply as was also the small colony which developed in Palm Beach. In 1901 a franchise was granted by the town of West Palm Beach but the water system at that time had only about 200 customers. In 1909 the hotel company sold the system to the West Palm Beach Water Company. It was not until after 1920 that the area showed a substantial growth.

The first filters, rated at 3-mgd. capacity, were installed in 1919-20. An additional 3-mgd. extension was added in 1925. The growth after 1924 dictated the construction of more substantial supply and distribution works. The present filtration plant was completed in 1927 and, at the same time, electrically operated pumps were installed. The existing filtration plant is rated at 16 mgd. Treatment consists of aeration, sedimentation, filtration and chlorination, with Clear Lake remaining as the source.

Elevated storage is provided by a 2-mil.gal. standpipe located in West Palm Beach about $3\frac{1}{2}$ mi. south of the pumping station. At the northerly end of Palm Beach there is a 1-mil.gal. ground storage reservoir which supply is pumped automatically into the system when required.

West Palm Beach and Palm Beach are connected by three subaqueous water crossings of 12-, 20- and 24-in. pipe.

Basis of Study

The information from which the data used in the study were secured was, for the early years, determined in an appraisal of the property made in 1928. Since 1925 the records of installation and retirement of pipe are complete.

The information on the installation of services, prior to 1925, was secured from existing records and data. Retirements of services prior to 1929 are incomplete and are not incorporated in this study.

Mortality Survival Study

Mortality survival studies were made of mains and services. Table 1 is a summary of the pipe installed, retired and the amount still in service, as well as other pertinent data. Table 2 is a similar summary of services. Figures 1 and 2 show the developed mortality survival curves of the respective facilities.

A summary of the principal items of Class B facilities is included hereafter.

SUMMARY OF CLASS B FACILITIES

WEST PALM BEACH, FLORIDA

Pumping Equipment

No.	Type	Power	Capacity	Year Installed	Year Retired	Salvage Value	Cost	Cause of Retirement	
1	Reciprocating High-Lift (Snow) *	Steam Engine	1.5 mgd.	1902	1926	\$200	\$ 4,500	OIS	
1	Reciprocating High-Lift (Platt)			1912	1926	200	5,500	IS	
1	Reciprocating High-Lift (Laidlaw)			1912	1930	200	11,487	IS	
1	Cent. Low-Lift (Sturtevant)			6 in.	1921	1930	50	2,011	S
1				8 in.	1921	1930	50	2,409	S
1				10 in.	1921	1903	50	2,950	S
1	Cent. Low-Lift	Turbine	1.5 mgd.	1922	1930	400	2,170	IS	
1	Cent. High-Lift		3.0 mgd.	1922	1930	500	6,722	S	
1	Cent. Low-Lift		4.0 mgd.	1923	1930	500	6,006	S	
1	Cent. High-Lift		5.0 mgd.	1924	1930	500	7,014	S	
1	Cent. Low-Lift		5.0 mgd.	1924	1930	500	5,260	S	
1	Cent. Well Pump				1925				
1	Cent. Basin Pump			1925					
1	Cent. Low-Lift	Electric	3.0 mgd.	1927					
1	Cent. High-Lift		3.0 mgd.	1927					
1	Cent. Low-Lift		8.0 mgd.	1927					
1	Cent. High-Lift		6.0 mgd.						
1	Cent. Low-Lift		15.0 mgd.	1927					
1	Cent. High-Lift		12.0 mgd.	1927					

* Purchased second-hand 1902.

SUMMARY OF CLASS B FACILITIES (contd.)

Miscellaneous Pumping Plant Equipment

No.		Year Installed	Year Retired	Salvage Value	Cost	Cause of Retirement
1	Electric Switchboard and Power Wiring	1927				
2	175-hp. Phoenix Boilers	1912	1930	\$ 200		S
1	Walsh & Weidner Boiler	1923	1930	400	\$ 8,155	S
1	Walsh & Weidner Boiler	1925	1930	400	7,430	S
1	Condenser	1922	1930	1,000	5,354	S
1	Condenser	1925	1930	2,500	20,995	S
1	16-in. Venturi Meter	1921				
1	30-in. Venturi Meter	1925				
1	20-in. Venturi Meter	1922	1930	Scrap	1,199	D
1	Dry Feed Machine	1936				
1	Dry Feed Machine	1924	1936	100	550	O
1	Wallace and Tiernan Ammoniator	1935				
2	Wallace and Tiernan Chlorinator	1925				
1	Wallace and Tiernan Chlorinator	1940				
2	Alum Feed Machines	1921	1930	Scrap	1,083	OS
3	Alum Feed Machines	1927				
3	Alum Hoppers and Scales	1927				

Purification Structures

2	Concrete Sedimentation Basins	1921				
2	Concrete Sedimentation Basins	1926				
1	3-mil.gal. Concrete Filter Unit	1921	1930	None	37,033	S
1	3-mil.gal. Concrete Filter Unit	1925	1930	None	36,816	S
4	5-mil.gal. Concrete Filter Unit	1927				

Source of Supply

1	Concrete Spillway	1938				
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Tanks and Reservoirs

1	0.5-mil.gal. Steel Tank and Tower	1922	1940	None	44,376	G
1	2-mil.gal. Steel Standpipe	1925				
1	400,000-gal. Standpipe *	1912				
1	250,000-gal. Steel Tank and Tower	1927				
1	400,000-gal. Concrete Clear Well	1921				
1	1-mil.gal. Concrete Clear Well	1927				
1	1-mil. gal. Concrete Reservoir	1940				

* Gunite lining added in 1938.

Symbols: O—Obsolescence

D—Functional Depreciation

S—Supercession—Steam to Electric

I—Inadequacy

G—Governmental Order

TABLE 1
SUMMARY OF MAINS
WEST PALM BEACH, FLORIDA

Size, <i>in.</i>	Kind	No. of Feet Installed	Percent- age of Total	No of Feet Retired	Percent- age of Total	No. of Feet in Service	Percent- age of Total	Year of First In- stallation	Average Age, <i>yr.</i>
2	Cast-iron unlined	8,679	1.3	0	0	8,679	1.5	1925	15.5
4		94,719	14.4	52,683	55.5	42,036	7.5	1901	26.3
6		73,038	11.1	9,987	10.5	63,051	11.2	1894	24.2
8		64,557	9.8	21,644	22.8	42,913	7.6	1894	22.8
10		5,635	0.9	0	0	5,635	1.0	1921	16.9
12		2,670	0.4	0	0	2,670	0.5	1922	18.5
14		4,585	0.7	0	0	4,585	0.8	1914	26.5
16		8,251	1.2	2,530	2.7	5,721	1.0	1920	17.2
20		1,160	0.2	0	0	1,160	0.2	1921	19.5
2½		11,041	1.7	0	0	11,041	2.0	1938	2.5
4	Cast-iron, cement-lined	1,069	0.2	134	0.1	935	0.2	1929	9.0
6		165,282	25.1	475	0.5	164,807	29.3	1925	13.3
8		112,462	17.1	7,550	7.9	104,912	18.6	1924	12.2
10		15,175	2.3	0	0	15,175	2.7	1925	15.0
12		31,884	4.8	0	0	31,884	5.7	1925	12.2
16		28,424	4.3	0	0	28,424	5.0	1925	11.1
20		17,475	2.7	0	0	17,475	3.1	1925	14.4
24		11,361	1.7	0	0	11,361	2.0	1926	14.2
30		645	0.1	0	0	645	0.1	1925	15.5
TOTAL		658,112	100.0	95,003	100.0	563,109	100.0		16.0
Percentage of Total		100.00		14.44		85.56			
Average Size, <i>in.</i>		7.9		5.8		8.3			

Mortality Survival Ratios

Size, in.	Kind	No. of Feet	Period Covered yr.	Percentage
2	Cast-iron unlined	8,679	15.5	100.000
4		94,719	39.5	27.390
6		73,038	46.5	83.935
8		64,557	45.5	44.223
10 and 12		8,305	19.5	100.000
Over 12	Cast-iron cement-lined	13,996	26.5	81.923
2½		11,041	2.5	100.000
4		1,069	11.5	87.465
6		165,282	15.5	99.527
8		112,462	16.5	92.436
10-30		104,964	15.5	100.000
TOTAL		658,112		

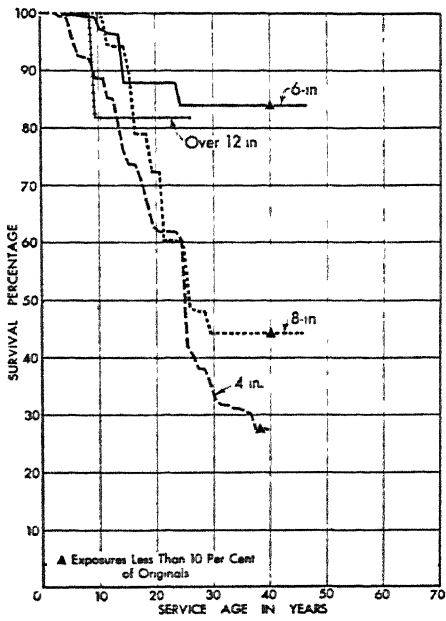


FIG. 1. Mortality Survival Curve—4-23-in. Cast-Iron Unlined Mains—West Palm Beach, Florida

BASE: Feet SIZE	SURVIVAL: 1894-1940	
	EXPOSURES ft.	RETIREMENTS ft.
4	94,719	52,683
6	73,038	9,987
8	64,557	21,644
10 and 12	8,305	0
Over 12	13,996	2,530

Causes of Retirement

Two factors have influenced early retirement of certain sections of pipe installed in the service area, namely, the effect of the corrosive action of sea water and the corrosive nature of the water served. Prior to about 1920, and in the period 1926-1935, the water served was quite corrosive. Between 1920 and 1926 a greater use of well water reduced its corrosive nature.

Table 3 is a summary of notes relative to the retirement, reconditioning,

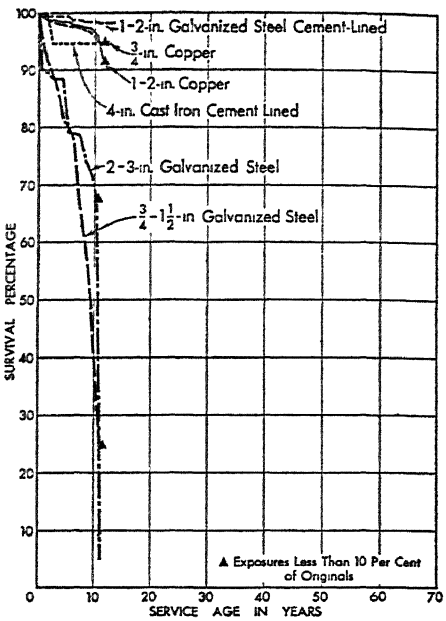


FIG. 2. Mortality Survival Curve—1/4-4-in. All Mains—West Palm Beach, Florida

BASE: Feet		SURVIVAL: 1927-1940	
SIZE	KIND	EXPOSURES	RETIREMENTS
in.		ft.	ft.
3-1 1/2	Galvanized Steel	7,939	3,583
2-3	Galvanized Steel	2,126	578
1-2	Galvanized Steel		
	Cement-Lined	79,588	1,372
3/4	Copper	37,494	840
1-2	Copper	33,215	722
4	Cast-Iron Cement-Lined	279	14

cement lining and reinstallation of a considerable portion of the larger size pipe which are shown in the tables as retired.

Acknowledgment

The collection and compilation of data pertaining to the West Palm Beach Water Company were under the supervision of R. W. Reynolds, Superintendent.

TABLE 2
SUMMARY OF SERVICES
WEST PALM BEACH, FLORIDA

Size, in.	Kind	No. of Feet Installed	No. of Feet Retired	No. of Feet in Service	Year of First Installation	Average Age, yr.
$\frac{3}{4}$	Galvanized steel	4,440	1,784	2,656	1929	5.5
1		1,797	1,299	498	1929	7.4
$1\frac{1}{4}$		525	272	253	1929	7.6
$1\frac{1}{2}$		1,177	228	949	1929	5.8
2		2,107	578	1,529	1929	4.3
3	Galvanized steel cement-lined	19	0	19	1929	11.2
1		27,788	784	27,004	1927	10.9
$1\frac{1}{4}$		27,296	294	27,002	1927	13.0
$1\frac{1}{2}$		17,053	0	17,053	1927	12.5
2		7,451	294	7,157	1927	11.9
$\frac{3}{4}$	Copper	37,494	840	36,654	1928	4.4
1		22,876	407	22,469	1928	4.9
$1\frac{1}{4}$		1,576	11	1,565	1930	4.7
$1\frac{1}{2}$		4,236	213	4,023	1928	4.9
2		4,527	91	4,436	1930	4.8
4	Cast-iron	279	14	265	1930	6.7
TOTAL		160,641	7,109	153,532		8.5
Percentage of Total		100.00	4.43	95.57		

Mortality Survival Ratios

Size, in.	Kind	No. of Feet	Period Covered yr.	Percentage
$\frac{3}{4}$ - $1\frac{1}{2}$	Galvanized steel	7,939	11.5	24.608
2 and 3	Galvanized steel	2,126	11.5	4.839
1-2	Galvanized steel cement-lined	79,588	13.5	98.153
$\frac{3}{4}$	Copper	37,494	12.5	94.901
1-2	Copper	33,215	12.5	89.791
4	Cast-iron	279	10.5	94.531
TOTAL		160,641		

TABLE 3
NOTES ON RETIREMENT OF PIPE
WEST PALM BEACH, FLORIDA

4-in. Cast-Iron Unlined

546 ft. of pipe laid in 1920 and retired in 1929 were relaid as unlined pipe in 1929.

486 ft. of the above 546 ft. were retired in 1932.

Balance of 4-in. pipe retirements abandoned as not economically recoverable or sold as second-hand pipe.

6-in. Cast-Iron Unlined

4,449 ft. of pipe laid in 1916 and retired in 1930 were reconditioned, cement-lined and relaid in 1930 and are still in service.

1,248 ft. of pipe laid in 1916 and retired in 1930 were reconditioned, cement-lined and relaid in 1931 and are still in service.

8-in. Cast-Iron Unlined

2,989 ft. of pipe laid in 1894 and retired in 1905 were relaid as unlined pipe in 1905.

2,989 ft. of pipe laid in 1894 and retired in 1915 were relaid as unlined pipe in 1915.

5,978 ft. of pipe, above noted, retired in 1930, were reconditioned, cement-lined and relaid in 1930 and are still in service.

284 ft. of pipe laid in 1925, retired in 1937, were reconditioned, cement-lined and relaid in 1939 and are still in service.

7,550 ft. of cement-lined pipe laid in 1926, retired in 1930, were reconditioned, cement-lined and relaid in 1930-31 and are still in service. This pipe, though listed as cement-

lined, was found to have only a light cement wash.

5,637 ft. of pipe laid in 1922, retired in 1938, were reconditioned, cement-lined and relaid in 1938-39-40 and are still in service.

16-in. Cast-Iron Unlined

1,830 ft. of pipe laid in 1920, retired in 1929 were reconditioned, cement-lined and relaid in 1930 and are still in service.

188 ft. of pipe laid in 1920, retired in 1929 were reconditioned, cement-lined and relaid in 1940 and are still in service.

Above pipe was installed in salt water and 512 ft. of pipe retired in 1929 were unfit for further service.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
WEST PALM BEACH, FLORIDA

MAINS

2-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	8,679	8,679	0
1940	0	0	0
TOTAL	8,679	8,679	0

4-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1901	23,064	9,074	13,990
1903	3,060	1,246	1,814
1905	3,060	1,314	1,746
1911	2,150	0	2,150
1912	11,162	5,753	5,409
1913	680	680	0
1915	7,548	0	7,548
1916	9,960	5,766	4,194
1917	5,740	1,135	4,605
1918	5,975	5,374	601
1919	3,256	0	3,256
1920	6,113	340	5,773
1924	3,745	2,730	1,015
1925	7,374	7,374	0
1926	1,040	1,040	0
1929	546	60	486
1930	96	0	96
1939	150	150	0
1940	0	0	0
TOTAL	94,719	42,036	52,683

Retirements by Years

Year						
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1901	1,055	1925	10,880	1926	517	1930
	1,042	1931	256	1932	240	1937
1903	780	1930	1,034	1940		
1905	521	1932	786	1938	310	1938
	129	1940				
1911	2,150	1925				
1912	3,105	1925	1,030	1926	183	1931
	1,091	1938				
1915	1,300	1921	3,248	1926	3,000	1934
1916	1,135	1929	505	1930	2,009	1934
	545	1936				

4-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Retirements by Years (contd.)</i>						
Year			Year			Year
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1917	450	1922	680	1931	2,280	1934
	1,195	1935				
1918	470	1925	131	1930		
1919	1,120	1925	2,136	1934		
1920	3,275	1925	310	1928	2,188	1929
1924	1,015	1933				
1929	486	1932				
1930	96	1934				

6-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1894	2,422	2,422	0
1895	4,220	4,220	0
1901	3,074	1,574	1,500
1906	850	850	0
1912	5,387	5,387	0
1913	1,082	1,082	0
1915	1,752	1,752	0
1916	20,030	14,240	5,790
1917	2,020	2,020	0
1918	3,262	2,947	315
1920	1,950	1,950	0
1921	1,292	1,292	0
1922	3,575	2,918	657
1924	13,390	11,665	1,725
1925	2,415	2,415	0
1926	2,527	2,527	0
1927	3,790	3,790	0
1940	0	0	0
TOTAL	73,038	63,051	9,987

Retirements by Years

Year						
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1901	1,500	1925				
1916	5,790	1930				
1918	315	1925				
1922	545	1929	112	1934		
1924	137	1928	105	1930	990	1934
	493	1935				

8-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1894	6,700	0	6,700
1895	3,000	3,000	0
1901	4,574	4,574	0
1905	7,219	1,474	5,745
1912	715	715	0
1913	725	725	0
1914	1,250	1,250	0
1915	2,989	0	2,989
1918	550	550	0
1922	10,990	5,064	5,926
1923	18,725	18,725	0
1925	5,390	5,106	284
1926	1,600	1,600	0
1931	130	130	0
1940	0	0	0
TOTAL	64,557	42,913	11,644

Retirements by Years

Year		Year		Year		Year	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1894	3,400	1905	3,300	1915			
1905	1,770	1924	2,989	1930	186	1931	
	800	1934					
	1915	2,989	1930				
	1922	5,926	1938				
	1925	284	1937				

10-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1921	1,920	1,920	0
1925	3,715	3,715	0
1940	0	0	0
TOTAL	5,635	5,635	0

12-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1922	2,670	2,670	0
1940	0	0	0
TOTAL	2,670	2,670	0

14-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1914	4,585	4,585	0
1940	0	0	0
TOTAL	4,585	4,585	0

16-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1920	2,530	0	2,530
1923	4,108	4,108	0
1924	1,613	1,613	0
1940	0	0	0
TOTAL	8,251	5,721	2,530

Retirements by Years

Year	Feet	Year
<i>Installed</i>		
1920	2,530	1929

20-IN. CAST-IRON UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1921	1,160	1,160	0
1940	0	0	0
TOTAL	1,160	1,160	0

24-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	10,669	10,669	0
1939	219	219	0
1940	153	153	0
TOTAL	11,041	11,041	0

4-IN. CAST-IRON CEMENT-LINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1929	80	80	0
1930	350	216	134
1931	39	39	0
1932	486	486	0
1934	114	114	0
1940	0	0	0
TOTAL	1,069	935	134

4-IN. CAST-IRON CEMENT-LINED
MAINS (contd.)

Retirements by Years		
Year	Feet	Year
Installed		
1930	134	1934

6-IN. CAST-IRON CEMENT-LINED MAINS

Feet			
Year	Installed	In Service	Retired
Installed			
1925	12,837	12,362	475
1926	87,647	87,647	0
1927	34,265	34,265	0
1928	5,795	5,795	0
1929	1,885	1,885	0
1930	5,922	5,922	0
1931	5,629	5,629	0
1932	557	557	0
1933	1,003	1,003	0
1934	6,591	6,591	0
1935	2,619	2,619	0
1940	532	532	0
TOTAL	165,282	164,807	475

Retirements by Years

Year	Feet	Year
Installed		
1925	475	1939

8-IN. CAST-IRON CEMENT-LINED MAINS

Feet			
Year	Installed	In Service	Retired
Installed			
1924	5,400	5,400	0
1925	4,930	4,930	0
1926	65,655	58,105	7,550
1927	7,096	7,096	0
1928	6,084	6,084	0
1929	1,371	1,371	0
1930	9,582	9,582	0
1931	3,876	3,876	0
1934	790	790	0
1935	779	779	0
1937	767	767	0
1938	1,675	1,675	0
1939	2,264	2,264	0
1940	2,193	2,193	0
TOTAL	112,462	104,912	7,550

Retirements by Years

Year	Feet	Year
Installed		
1926	7,550	1930

10-IN. CAST-IRON CEMENT-LINED MAINS

Feet			
Year	Installed	In Service	Retired
Installed			
1925	8,705	8,705	0
1926	6,160	6,160	0
1928	310	310	0
1940	0	0	0
TOTAL	15,175	15,175	0

12-IN. CAST-IRON CEMENT-LINED MAINS

Feet			
Year	Installed	In Service	Retired
Installed			
1925	7,828	7,828	0
1926	2,811	2,811	0
1927	9,800	9,800	0
1929	4,657	4,657	0
1930	994	994	0
1935	5,367	5,367	0
1937	427	427	0
1940	0	0	0
TOTAL	31,884	31,884	0

16-IN. CAST-IRON CEMENT-LINED MAINS

Feet			
Year	Installed	In Service	Retired
Installed			
1925	12,465	12,465	0
1926	38	38	0
1927	3,833	3,833	0
1930	5,748	5,748	0
1937	446	446	0
1939	4,533	4,533	0
1940	1,361	1,361	0
TOTAL	28,424	28,424	0

20-IN. CAST-IRON CEMENT-LINED MAINS

Feet			
Year	Installed	In Service	Retired
Installed			
1925	4,085	4,085	0
1926	10,995	10,995	0
1927	1,352	1,352	0
1931	1,043	1,043	0
1940	0	0	0
TOTAL	17,475	17,475	0

SURVIVAL AND RETIREMENT

24-IN. CAST-IRON CEMENT-LINED MAINS				30-IN. CAST-IRON CEMENT-LINED MAINS			
Year	Feet			Year	Feet		
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1926	7,995	7,995	0	1925	645	645	0
1927	3,366	3,366	0	1940	0	0	0
1940	0	0	0				
TOTAL	11,361	11,361	0	TOTAL	645	645	0

SERVICES

 $\frac{3}{4}$ -IN. GALVANIZED STEEL SERVICES

Year	Feet			Year	Feet		
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
Not Complete Before 1929				1936	279	195	84
1929	1,041	595	446	1937	348	277	71
1930	435	37	398	1938	1,179	1,097	82
1931	427	32	395	1939	116	85	31
1932	284	80	204	1940	5	0	5
1933	37	15	22				
1934	256	229	27	TOTAL	4,440	2,656	1,784
1935	33	14	19				

Retirements by Years

Year							Year						
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1929	26	1930	2	1933	10	1934	1933	1	1935	1	1937	5	1938
	6	1935	29	1936	4	1937		1	1939	14	1940		
	47	1938	132	1939	190	1940	1934	1	1936	8	1938	18	1939
1930	19	1933	21	1934	9	1936	1935	8	1937	1	1938	7	1939
	22	1937	68	1938	76	1939		3	1940				
	183	1940					1936	1	1936	17	1938	42	1939
1931	18	1931	20	1932	112	1935		24	1940				
	29	1936	93	1938	62	1939	1937	10	1938	57	1939	4	1940
	61	1940					1938	27	1938	50	1939	5	1940
1932	9	1932	72	1933	7	1934	1939	10	1939	21	1940		
	3	1936	32	1938	62	1939	1940	5	1940				
	19	1940											

1-IN. GALVANIZED STEEL SERVICES

Year	Feet			Year	Feet		
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1929	182	114	68	1936	100	36	64
1930	323	44	279	1937	171	28	143
1931	250	49	201	1938	300	45	255
1932	200	47	153	1939	75	33	42
1933	50	7	43	1940	5	0	5
1934	41	34	7				
1935	100	61	39	TOTAL	1,797	498	1,299

1-IN. GALVANIZED STEEL SERVICES (contd.)

Retirements by Years

Year							Year						
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1929	1	1935	67	1940			1934	7	1940				
1930	5	1931	35	1934	1	1936	1935	39	1939				
	22	1937	1	1938	4	1939	1936	18	1938	28	1939	18	1940
	211	1940					1937	6	1937	8	1938	41	1939
1931	1	1935	11	1938	55	1939		88	1940				
	74	1940					1938	244	1938	9	1939	2	1940
1932	11	1938	52	1939	90	1940	1939	34	1939	8	1940		
1933	33	1939	10	1940			1940	5	1940				

1½-IN. GALVANIZED STEEL SERVICES

Year		Feet			
Installed	Installed	In Service	Retired		
1929	76	5	71		
1930	90	19	71		
1931	189	60	129		
1932	71	71	0		
1934	41	41	0		
1936	46	45	1		
1938	12	12	0		
1940	0	0	0		
TOTAL	525	253	272		

Retirements by Years

Year						
Installed	Feet	Year	Feet	Year	Feet	Year
1929	4	1934	4	1935	8	1938
	55	1940				
1930	12	1936	29	1937	9	1939
	21	1940				
1931	14	1936	77	1938	13	1939
	25	1940				
1936	1	1940				

1½-IN. GALVANIZED STEEL SERVICES

Year		Feet			
Installed	Installed	In Service	Retired		
1929	51	0	51		
1930	160	156	4		
1931	150	55	95		
1932	231	230	1		
1933	100	54	46		
1934	50	38	12		
1937	65	46	19		
1939	370	370	0		
1940	0	0	0		
TOTAL	1,177	949	228		

1½-IN. GALVANIZED STEEL SERVICES (contd.)

Retirements by Years

Year				
Installed	Feet	Year	Feet	Year
1929	51	1930		
1930	4	1940		
1931	13	1939	82	1940
1932	1	1940		
1933	10	1937	36	1940
1934	12	1935		
1937	19	1938		

2-IN. GALVANIZED STEEL SERVICES

Year		Feet			
Installed	Installed	In Service	Retired		
1929	276	0	276		
1930	160	130	30		
1931	232	221	11		
1932	54	30	24		
1936	173	165	8		
1937	232	46	186		
1938	535	533	2		
1939	370	370	0		
1940	75	34	41		
TOTAL	2,107	1,529	578		

Retirements by Years

Year						
Installed	Feet	Year	Feet	Year	Feet	Year
1929	80	1934	1	1935	12	1938
	2	1939	181	1940		
1930	1	1930	8	1939	21	1940
1931	2	1938	9	1939		
1932	1	1939	23	1940		
1936	1	1937	6	1938	1	1939
1937	170	1937	16	1939		
1938	2	1938				
1940	41	1940				

3-IN. GALVANIZED STEEL SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1929	14	14	0
1930	5	5	0
1940	0	0	0
TOTAL	19	19	0

4-IN. CAST-IRON SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1930	117	117	0
1934	19	19	0
1935	22	22	0
1937	86	72	14
1938	12	12	0
1940	23	23	0
TOTAL	279	265	14

Retirements by Years

Year	Feet	Year
1937	14	1939

1-IN. COPPER SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1928	243	240	3
1929	340	320	20
1930	3,472	3,355	117
1931	2,617	2,531	86
1932	1,797	1,762	35
1933	1,106	1,097	9
1934	2,521	2,519	2
1935	322	316	6
1936	3,083	2,998	85
1937	3,550	3,450	100
1938	6,054	5,895	159
1939	8,662	8,470	192
1940	3,727	3,701	26
TOTAL	37,494	36,654	840

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year
1928	3	1934				
1929	2	1934	2	1936	16	1939
1930	15	1931	16	1934	11	1938
	29	1939	46	1940		

1-IN. COPPER SERVICES (contd.)

Retirements by Years (contd.)

Year	Feet	Year	Feet	Year	Feet	Year
1931	24	1931	2	1934	35	1936
	20	1937	3	1939	2	1940
1932	2	1933	4	1934	16	1939
	13	1940				
1933	2	1936	7	1939		
1934	1	1934	1	1937		
1935	1	1937	5	1938		
1936	5	1936	18	1937	34	1938
	27	1939	1	1940		
1937	12	1937	32	1938	50	1939
	6	1940				
1938	4	1938	116	1939	39	1940
1939	156	1939	36	1940		
1940	26	1940				

1-IN. COPPER SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1928	252	240	12
1929	370	333	37
1930	3,814	3,792	22
1931	1,310	1,293	17
1932	552	523	29
1933	508	504	4
1934	2,218	2,152	66
1935	666	666	0
1936	1,821	1,816	5
1937	2,361	2,283	78
1938	1,566	1,551	15
1939	1,801	1,750	51
1940	5,637	5,566	71
TOTAL	22,876	22,469	407

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year
1928	12	1940				
1929	12	1931	25	1935		
1930	7	1931	12	1938	3	1939
1931	17	1934				
1932	3	1933	26	1938		
1933	4	1939				
1934	66	1940				
1936	5	1936				
1937	21	1937	16	1938	38	1939
	3	1940				
1938	14	1938	1	1939		
1939	51	1939				
1940	71	1940				

1½-IN. COPPER SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	125	125	0
1931	121	121	0
1932	135	128	7
1933	54	54	0
1934	415	415	0
1935	15	15	0
1936	50	50	0
1937	46	42	4
1940	615	615	0
TOTAL	1,576	1,565	11

Retirements by Years

Year	Feet	Year	Feet
<i>Installed</i>			
1932	7	1936	
1937	4	1937	

1½-IN. COPPER SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1928	274	274	0
1929	154	100	54
1930	364	304	60
1931	185	185	0
1932	146	146	0
1933	28	28	0
1934	435	435	0
1935	169	168	1
1936	125	125	0
1937	354	354	0
1938	494	494	0
1939	1,167	1,069	98
1940	341	341	0
TOTAL	4,236	4,023	213

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year	Feet
<i>Installed</i>							
1929	3	1934	7	1938	44	1940	
1930	40	1930	14	1934	3	1938	
	3	1940					
1935	1	1937					
1939	98	1940					

2-IN. COPPER SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1930	523	460	63
1931	222	222	0
1932	231	231	0
1933	55	55	0
1934	980	980	0
1935	128	127	1
1936	250	250	0
1937	515	506	9
1938	360	354	6
1939	403	392	11
1940	860	859	1
TOTAL	4,527	4,436	91

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year	Feet
<i>Installed</i>							
1930	3	1931	8	1938	52	1940	
1935	1	1939					
1937	9	1937					
1938	4	1939	2	1940			
1939	1	1939	10	1940			
1940	1	1940					

1-IN. GALVANIZED STEEL CEMENT-LINED SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	11,760	11,713	47
1928	5,212	5,101	111
1929	2,470	2,376	94
1930	645	468	177
1931	430	427	3
1932	1,305	1,235	70
1933	652	638	14
1934	1,000	976	24
1935	305	297	8
1936	1,006	917	89
1937	1,669	1,546	123
1938	1,186	1,162	24
1939	132	132	0
1940	16	16	0
TOTAL	27,788	27,004	784

1-IN. GALVANIZED STEEL CEMENT-LINED
SERVICES (contd.)*Retirements by Years*

<i>Year</i>		<i>Feet</i>		<i>Year</i>		<i>Feet</i>	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1927	10	1930	37	1931			
1928	17	1931	6	1933	48	1934	
	13	1937	27	1939			
1929	33	1929	3	1930	1	1932	
	1	1935	7	1936	44	1938	
	5	1939					
1930	5	1931	35	1934	1	1936	
	1	1938	4	1939	131	1940	
1931	3	1935					
1932	1	1932	9	1937	60	1939	
1933	14	1939					
1934	2	1935	22	1939			
1935	8	1939					
1936	46	1936	3	1937	40	1938	
1937	83	1937	14	1938	4	1939	
	22	1940					
1938	21	1939	3	1940			

1½-IN. GALVANIZED STEEL CEMENT-LINED
SERVICES

<i>Year</i>		<i>Feet</i>	
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	19,500	19,487	13
1928	4,880	4,880	0
1929	1,058	803	255
1930	1,368	1,343	25
1931	414	414	0
1936	76	75	1
1940	0	0	0
TOTAL	27,296	27,002	294

Retirements by Years

<i>Year</i>		<i>Feet</i>		<i>Year</i>		<i>Feet</i>	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1927	13	1933					
1929	33	1934	222	1935			
1930	25	1936					
1936	1	1936					

1½-IN. GALVANIZED STEEL CEMENT-LINED
SERVICES

<i>Year</i>		<i>Feet</i>	
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	11,900	11,900	0
1928	3,072	3,072	0
1929	92	92	0
1930	111	111	0
1931	721	721	0
1932	167	167	0
1933	8	8	0
1934	292	292	0
1936	249	249	0
1937	59	59	0
1938	327	327	0
1939	55	55	0
1940	0	0	0
TOTAL	17,053	17,053	0

2-IN. GALVANIZED STEEL CEMENT-LINED
SERVICES

<i>Year</i>		<i>Feet</i>	
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	4,070	4,049	21
1928	1,139	1,110	29
1929	739	715	24
1930	341	141	200
1931	28	28	0
1932	52	43	9
1933	25	25	0
1934	636	636	0
1935	165	154	11
1936	201	201	0
1937	11	11	0
1938	44	44	0
1940	0	0	0
TOTAL	7,451	7,157	294

Retirements by Years

<i>Year</i>		<i>Feet</i>		<i>Year</i>		<i>Feet</i>	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1927	18	1932	3	1935			
1928	29	1929					
1929	8	1930	2	1934	14	1935	
1930	200	1938					
1932	9	1932					
1935	11	1939					

Winnipeg, Manitoba

As of December 31, 1942

THE Greater Winnipeg Water District represents the group of municipalities centered in the city of Winnipeg, located in the south central part of the Province of Manitoba. It was formed through incorporation by the legislature and is managed by a commission under the jurisdiction of an administration board composed of representatives from the municipalities concerned. These communities include the cities of Winnipeg and St. Boniface; the municipalities of St. James, Tuxedo, Fort Garry, St. Vital, East and West Kildonan; and the town of Transcona. The aggregate population of this area is approximately 260,000.

This report is confined to studies of distribution facilities owned and operated by the city of Winnipeg. Besides being the capital of Manitoba, Winnipeg, the fourth largest Canadian city, is the urban center of central Canada and is the retail, wholesale and trading center of the area. It is also a railroad center and has important manufacturing establishments represented in wood-working, clothing, iron, farm implements and packing plants. The city is located on level terrain at the confluence of the Red and Assiniboine rivers.

At the date of the study there were 40,471 consumers receiving service within the city. Water purchased by the city from the district and used within its service area averaged 16.4 mgd. (Imperial gallons are used

throughout), serving 227,000 people, or about 72.3 gpd. per capita.

Development of the Existing System

The original water facilities serving Winnipeg secured their supply from the Assiniboine River. These works were constructed by a private company and so operated from about 1882 to 1899 when they were purchased by the city. The city in 1912 joined with the surrounding municipalities in promoting the formation of the Greater Winnipeg Water District, which developed the existing supply and furnishes water in bulk to the several communities by meter measurement.

About the time of the purchase of the privately-operated works the development of a well supply was started and from 1901 to the commencement of operation of the district supply system in 1919 the entire supply for the city was obtained from wells.

The present supply is secured from Shoal Lake located about 95 mi. east of the city and flows by gravity through a concrete aqueduct to the city. The district supplies water in bulk, under low pressure, from the aqueduct to the city of Winnipeg, which, upon receipt of the water at the reservoirs, assumes control of its storage, treatment, pumping and distribution, the latter functions being carried out under the direction of the city engineer. The city in turn provides treated water under serv-

TABLE 1
SUMMARY OF MAINS—WINNIPEG, MANITOBA

Size, in.	Kind	No. of Feet Installed	Percentage of Total	No of Feet Retired	Percentage of Total	No. of Feet in Service	Percentage of Total	Year of First Installation	Average Age, yr.
3	Cast-iron unlined	199	0.01	0	0	199	0.01	1942	0.5
4		195,136	10.93	58,955	48.89	136,181	8.18	1882	40.9
5		14,775	0.83	9,005	7.47	5,770	0.35	1883	54.4
6		951,972	53.30	26,475	21.96	925,497	55.58	1882	32.7
8		244,035	13.66	20,856	17.29	223,179	13.40	1882	27.7
10		164,306	9.19	532	0.44	163,774	9.84	1882	31.4
12		94,684	5.30	3,458	2.87	91,226	5.48	1882	28.5
14		40,268	2.25	45	0.04	40,223	2.42	1889	33.6
16		18,868	1.06	0	0	18,868	1.13	1899	36.9
18		39,750	2.26	1,113	0.92	38,637	2.32	1899	26.5
20	Cast-iron victaulic unlined	4,200	0.23	148	0.12	4,052	0.24	1899	41.6
24		11	0.00	0	0	11	0.00	1919	23.5
10		839	0.05	0	0	839	0.05	1904	36.0
12		782	0.04	0	0	782	0.05	1925	17.5
18		113	0.01	0	0	113	0.01	1939	3.5
6		571	0.02	0	0	571	0.03	1940	2.5
10		8,854	0.50	0	0	8,854	0.53	1937	4.0
14		431	0.02	0	0	431	0.03	1932	10.5
18		859	0.05	0	0	859	0.05	1932	9.6
24		3,899	0.22	0	0	3,899	0.23	1938	4.5
36	Steel, concrete covered	1,200	0.07	0	0	1,200	0.07	1919	23.5
TOTAL		1,785,752	100.00	120,587	100.00	1,665,165	100.00		32.3
Percentage of Total		100.00		6.75		93.25			
Average Size, in.		7.44		5.61		7.54			

Mortality Survival Ratios

Size, in.	Kind	No. of Feet	Period Covered, yr.	Percentage
3-5	Cast-iron unlined	210,110	60.5	36.572
6		951,972	60.5	68.606
8		244,035	60.5	17.914
10-12		258,990	60.5	97.800
Over 12		103,097	53.5	97.997
6-18	Asbestos-cement	10,715	10.5	100.000
10-18	Cast-iron flexible and victaulic	1,734	38.5	100.000
24	Concrete	3,899	4.5	100.000
36	Steel, concrete covered	1,200	23.5	100.000
TOTAL		1,785,752		

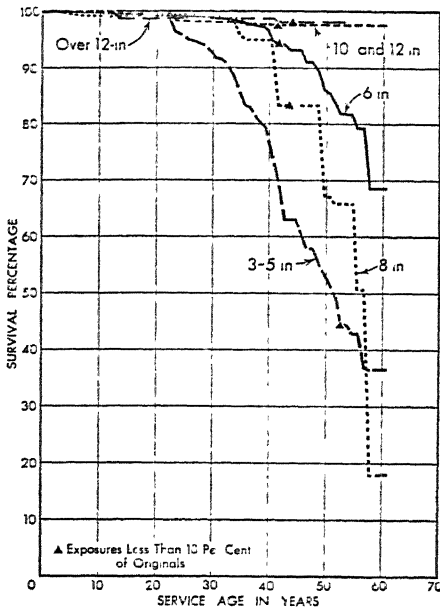


FIG. 1. Mortality Survival Curve—3-24-in. Cast-Iron Unlined Mains—Winnipeg, Manitoba

BASE: Feet		SURVIVAL: 1882-1942	
SIZE in.	EXPOSURES ft.	RETIREMENTS ft.	
3-5	210,110	67,960	
6	951,972	26,475	
8	244,035	20,856	
10 and 12	258,990	3,990	
Over 12	103,097	1,306	

ice pressures to the municipalities of East Kildonan, West Kildonan, Fort Garry, St. James, Charleswood, the town of Tuxedo, and the village of Brooklands. Water in bulk is also supplied by the district, through independent connections to the aqueduct, to the city of St. Boniface and the town of Transcona, which also store, treat, pump and distribute the water to the citizens resident in these municipalities. St. Boniface in turn provides water under service pressure to the municipality of St. Vital.

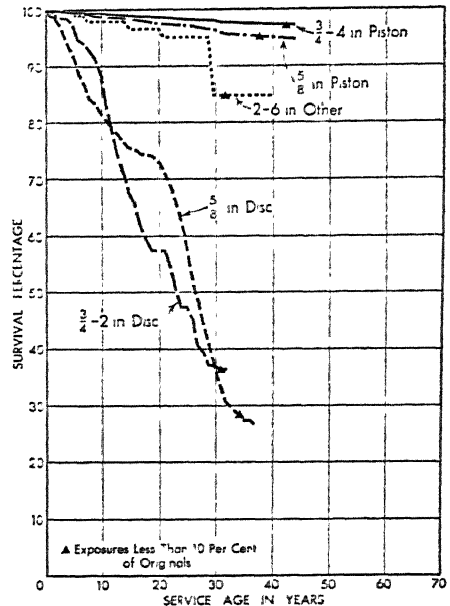


FIG. 2. Mortality Survival Curve—1-6-in. Meters—Winnipeg, Manitoba

BASE: Unit		SURVIVAL: 1899-1942	
SIZE in.	KIND	EXPOSURES Units	RETIREMENTS Units
1-6	Disc	2,056	1,132
1-6	Piston	37,646	1,401
2-3	Disc	262	92
2-4	Piston	2,955	58
2-6	Other	112	7

The Shoal Lake supply was first considered in 1912 but preliminary work over the several following years, including the building of a standard gage railroad along the line of the aqueduct, was required before actual construction could be started in 1915. Water was turned into the system in April 1919.

Shoal Lake is an arm of the Lake of the Woods, the geography of which is international and is situated about 95 mi. east of and 300 ft. in elevation above the city. Shoal Lake has a drainage area of about 360 sq.mi., with

TABLE 2
SUMMARY OF METERS
WINNIPEG, MANITOBA

Size, in.	Kind	Number Installed	Number Identified	Number Retired	Number in Service	Average Age, yr.
$\frac{5}{8}$	Disc	2,099	2,056	1,132	924	17.4
$\frac{3}{4}$		54	51	9	42	1.5
1		136	117	35	82	15.5
$1\frac{1}{2}$		54	30	8	22	8.7
2		59	56	35	21	13.6
3		9	8	5	3	22.2
$\frac{5}{8}$	Piston	37,937	37,646	1,401	36,245	29.0
$\frac{3}{4}$		1,695	1,662	27	1,635	33.8
1		756	743	13	730	30.9
$1\frac{1}{2}$		322	322	6	316	24.7
2		215	214	11	203	25.5
3		13	12	1	11	32.9
4	Current	2	2	0	2	30.5
2		4	4	4	0	—
3		19	18	2	16	32.1
4		8	7	1	6	26.8
6		1	1	0	1	16.5
3		55	55	0	55	17.0
4	Compound	23	23	0	23	16.2
6		4	4	0	4	15.8
TOTAL		43,465	43,031	2,690	40,341	28.8
Percentage of Total			100.0	6.25	93.75	

Mortality Survival Ratios

Size, in.	Kind	Number	Period Covered, yr	Percentage
$\frac{5}{8}$	Disc	2,056	36.5	26.810
$\frac{3}{4}$	Piston	37,646	43.5	94.954
$\frac{1}{2}$ -3	Disc	262	31.5	36.221
$\frac{3}{4}$ -4	Piston	2,955	43.5	97.369
2-6	Other	112	39.5	84.976
TOTAL		43,031		

a water area of 107 sq.mi., and, with the Lake of the Woods, constitutes a supply which may be said to be virtually inexhaustible.

The intake at Shoal Lake is a concrete chamber with trash racks, screens and stop logs for control. The aqueduct, 96.5 mi. in total length from the

lake to a point about 16 mi. east of the city's reservoir, consists of arch gravity sections varying from 6 ft. 4 $\frac{3}{4}$ in. by 5 ft. 4 $\frac{3}{4}$ in. to 10 ft. 9 in. by 9 ft., depending on the slope. Its designed capacity was 85 mgd. but tests subsequently made indicate that its actual capacity is about 100 mgd.

From the end of the gravity section, 16 mi. east of the city, the conduit continues as an 8-ft. reinforced concrete pipe of equivalent capacity for a distance of 4 mi. to a proposed reservoir site at Deacon. Continuing 9.3 mi. to the Red River the reinforced concrete pipe is 66 in. in diameter, with a capacity of 52 mgd., and thence continues

2.4 mi. as a 48-in. pipe, having a capacity of 30 mgd. to the reservoirs. When consumption requirements dictate, booster pumping is proposed at the Red River crossing.

The Greater Winnipeg Water District's 48-in. main terminates in reservoirs located within the city from which the supply is pumped by the city with-

TABLE 3
SUMMARY OF SERVICES
WINNIPEG, MANITOBA

Size, in.	Kind	No. of Feet Installed	No. of Feet Identified	No. of Feet Retired	No. of Feet in Service	Average Age, yr.
$\frac{1}{8}$	Galvanized- iron	259	156	156	0	
$\frac{3}{8}$		33	33	33	0	
$\frac{1}{2}$		2,123	1,490	1,490	0	
1		655	399	399	0	
$1\frac{1}{4}$		28	0	0	0	
$1\frac{1}{2}$		132	98	98	0	
$1\frac{3}{4}$	Wrought-iron	6,017	5,190	5,190	0	
2		112	112	112	0	
$2\frac{1}{4}$		19,186	17,139	17,139	0	
$2\frac{1}{2}$		4,109	2,944	2,944	0	
$2\frac{3}{4}$		163	163	163	0	
3		286	266	266	0	
$3\frac{1}{4}$	Lead	651	605	605	0	
$3\frac{1}{2}$		123	66	66	0	
$3\frac{3}{4}$		153	153	153	0	
4		657,933	655,752	101,050	554,702	29.8
$4\frac{1}{4}$		260,603	259,905	39,445	220,460	32.8
$4\frac{1}{2}$		109,297	107,737	21,166	86,571	28.7
$4\frac{3}{4}$	Copper	51,411	51,054	5,754	45,300	28.5
5		122	122	18	104	32.5
$5\frac{1}{4}$		421	421	77	344	24.6
$5\frac{1}{2}$		77,625	77,556	652	76,904	12.3
$5\frac{3}{4}$		17,765	17,659	132	17,527	12.0
6		93,975	93,901	407	93,494	4.8
$6\frac{1}{4}$	Cast-iron	14,832	14,832	304	14,528	8.0
$6\frac{1}{2}$		344	344	0	344	2.5
$6\frac{3}{4}$		593	593	0	593	5.0
7		2,313	2,313	0	2,313	10.2
8		460	460	185	275	42.4
$8\frac{1}{4}$		11,684	11,674	413	11,261	28.9
$8\frac{1}{2}$		7,243	7,243	55	7,188	19.7
$8\frac{3}{4}$		739	739	0	739	16.9
TOTAL		1,341,390	1,331,119	198,472	1,132,647	26.3
Percentage of Total			100.00	14.67	85.33	

TABLE 3 (contd.)
Mortality Survival Ratios

Size, in.	Kind	No. of Feet	Period Covered, yr.	Percentage
$\frac{1}{2}$ - $\frac{3}{4}$	Galvanized-iron and Wrought-iron	24,120	38.5	0.000
1-3		4,694	34.5	0.000
$\frac{1}{2}$		655,752	48.5	63.600
$\frac{3}{8}$		259,905	47.5	72.638
$\frac{1}{2}$	Lead	107,737	48.5	60.416
$\frac{3}{4}$		51,597	47.5	82.697
1-2		93,901	15.5	98.322
$\frac{1}{2}$ -2 (excl. $\frac{1}{2}$)		113,297	17.5	98.870
3-8	Cast-iron	20,116	55.5	91.934
TOTAL		1,331,119		

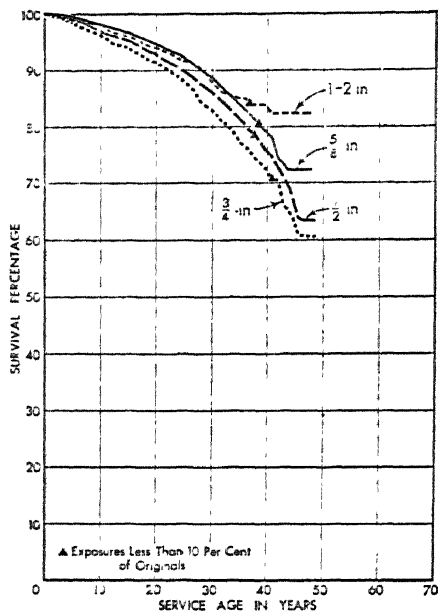


FIG. 3. Mortality Survival Curve— $\frac{1}{2}$ -2-in.
Lead Services—Winnipeg, Manitoba

BASE: Feet SURVIVAL: 1894-1942

SIZE in.	EXPOSURES ft.	RETIREMENTS ft.
$\frac{1}{2}$	655,752	101,050
$\frac{3}{8}$	259,905	39,441
$\frac{1}{2}$	107,737	21,166
1-2	51,597	5,849

out treatment other than algal control and ammonia and chlorination to the distribution system. The original covered concrete reservoir of 6-mil.gal. capacity was built in 1906 and abandoned in 1929. There are two reservoirs now in service; one, a concrete covered reservoir of 18-mil.gal. capacity, was constructed in 1913, and the other, an open concrete 40-mil.gal. reservoir was constructed in 1930.

The existing high-lift pumping station, constructed in 1930, replaced a steam turbo-generated electric station constructed in 1901. Pumping equipment consists of six motor-driven centrifugal pumps having a total rated capacity of 45 mgd. Power is secured chiefly from the city's hydroelectric system but standby connections are maintained with several private sources.

In addition the city operates an auxiliary electric power and central steam heating plant adjacent to the pumping station which can furnish power in emergencies.

The normal pressure maintained at the pumping station is about 75 psi. In addition to the normal water distribution system the city has a separate

TABLE 4
CAUSES OF RETIREMENTS OF CAST-IRON UNLINED MAINS
WINNIPEG, MANITOBA

Size, in.	Feet Retired	Cause of Retirement—Percentage of Total			
		Wear and Tear	Inadequacy	Obsolescence	Action of Public Authority
4	58,955	83.2	0.7	13.7	12.4
5	9,005	100.0			
6	26,475	61.8	3.7	14.2	20.3
8	20,856	74.0	1.4	18.0	6.6
10	532	9.2		66.4	24.4
12	3,458			21.0	79.0
14	45				100.0
18	1,113				100.0
20	148				100.0
TOTAL	120,587	74.6	1.4	13.8	10.2

fire service system started in 1908 which serves the principal mercantile and industrial areas and is used for fire protection purposes only. This system has an independent connection to the Shoal Lake conduit and, through booster pumping, maintains a pressure of about 75 psi. in the fire mains. This in turn can be raised to as high as 300 lb. when required.

The main distribution system within the city consists of approximately 331.13 mi. of mains 3 to 36 in. in diameter (inclusive of 12.8 mi. in the high-pressure system), predominantly Class C, pit-cast, tar-coated pipe laid with lead joints with a cover of about 7 ft. Equivalent class asbestos-cement and bolted-joint "Universal" cast-iron pipe has lately been used. Only a small amount of centrifugally-cast cast-iron pipe has been used.

There are 40,794 service connections which, with the exception of the larger cast-iron services and recent (since 1927) copper installations, are of lead. The city's system has 5,375 valves,

2,737 hydrants and 40,471 meters as of the date of the study. Active services are about 100 per cent metered, and these meters account for approximately 80 per cent of the total amount of water purchased.

Basis of Study

The records of installation and retirement of pipe, in the form of field books, are substantially complete from the original date of construction in 1882 to date.

The records of meters are substantially complete from 1899 to date and of services from 1882 to date. Class B facilities are not included in this study.

Mortality Survival Study

Mortality studies of mains, meters and services were made. Table 1 is a summary of the pipe installed, the amount retired and that still in service, as well as other pertinent data relative thereto. Figure 1 shows the mortality survival curves covering the rec-

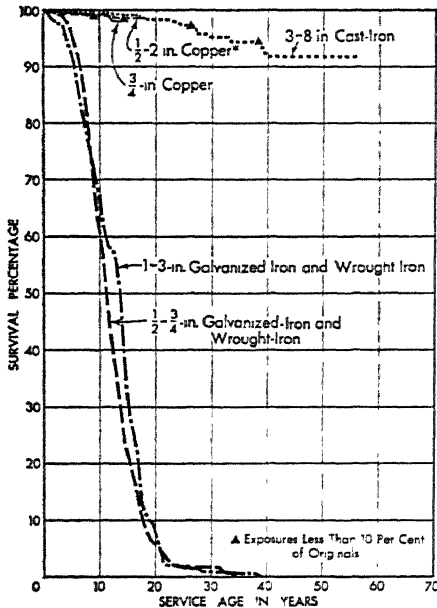


FIG. 4.—Mortality Survival Curve— $\frac{1}{2}$ -8-in. Services Other Than Lead—Winnipeg, Manitoba

BASE: Feet SURVIVAL: 1884-1942

SIZE in.	KIND	EXPO- SURES ft.	RETIRE- ments ft.
$\frac{1}{2}$ - $\frac{3}{4}$	Galvanized-Iron and Wrought-Iron	24,120	24,120
1-3	Galvanized-Iron and Wrought-Iron	4,694	4,694
$\frac{1}{2}$	Copper	93,901	407
$\frac{1}{2}$ -2	Copper*	113,297	1,096
3-8	Cast-Iron	20,116	653

* Excluding $\frac{1}{4}$ -in.

ord of the amount and sizes of pipe grouped as shown.

Tables 2 and 3 are similar summaries of meters and services and Figs. 2, 3 and 4 present the applicable mortality survival curves.

Causes of Retirement

The causes of retirement of mains have been determined and classified

under four general divisions as shown in Table 4. Of the total retirements of water mains 74.6 per cent were caused by wear and tear, 1.4 per cent by inadequacy, 13.8 per cent by obsolescence and 10.2 per cent by the action of public authorities. Two major factors have been influential in causing retirement of pipe because of wear and tear. The character of the soil in the Red River Valley has had much to do with the disintegration of pipe material. The soil contains certain soluble salts, including sulfates of sodium, magnesium and calcium. As a result, disintegration of the pipe has been relatively rapid.

The other major factor causing disintegration of pipe material has been electrolysis. Experts investigated this influence in 1906, 1909 and 1915, and concluded that electrolysis was particularly active in Winnipeg and a considerable number of retirements of pipe have been caused by its action.

While an analysis of the causes of retirement of meters has not been made, the retirement of large numbers of disc meters has been the result of standardization on the piston type meter. Further, in repairing meters, whenever a new upper or lower casing is renewed the original meter is considered retired, although a major part of such meter may remain in service.

Spot checks were made to determine the cause of retirement of $\frac{1}{2}$ -1-in. lead services by analyzing the retirements made at six-year intervals. Table 5 shows the results of the analysis with the retirements separated into five classifications.

Acknowledgments

The collection and compilation of data relative to the installation and re-

TABLE 5
CAUSES OF RETIREMENT OF LEAD SERVICES
WINNIPEG, MANITOBA

Size, in.	Cause of Retirement	No. of Feet Retired						Total No. of Feet Retired	Percent- age of Total
		Installed in Year							
		1894	1900	1906	1912	1918	1924		
$\frac{1}{2}$	Not used	835	828	3,060	414	16	34	5,187	21.6
	Inadequate	160	290	1,439	154	28		2,071	8.7
	Street paving		92	28	186			306	1.2
	Corrosion	1,277	5,050	6,720	2,491	192	182	15,912	66.1
	Other	163	178	55	138	46		580	2.4
	TOTAL	2,435	6,438	11,302	3,382	282	216	24,056	100.0
$\frac{5}{8}$	Not used		425	1,620	192		14	2,251	27.5
	Inadequate		106	166				272	3.3
	Street paving			168	14			182	2.2
	Corrosion		941	2,829	1,460			5,230	63.8
	Other		131	104	24			259	3.2
	TOTAL		1,603	4,887	1,690		14	8,194	100.0
$\frac{3}{4}$	Not used	173	330	824	192	102	84	1,705	35.4
	Inadequate	15		168			46	229	4.7
	Street paving			17	14		52	83	1.8
	Corrosion	466	398	435	1,187			2,486	51.5
	Other	126	151				42	319	6.6
	TOTAL	780	879	1,444	1,393	102	224	4,822	100.0
1	Not used			109	90	163	264	686	43.5
	Inadequate			28	84			112	7.1
	Street paving				146			146	9.3
	Corrosion			251	190	43	149	633	40.1
	Other								
	TOTAL			448	510	206	413	1,577	100.0
TOTAL—Not used		1,008	1,583	5,673	888	281	396	9,829	25.4
Inadequate		175	396	1,801	238	28	46	2,684	7.0
Street paving			92	213	360		52	717	1.9
Corrosion		1,743	6,389	10,235	5,328	235	331	24,261	62.7
Other		289	460	159	162	46	42	1,158	3.0
TOTAL		3,215	8,920	18,081	6,976	590	867	38,649	100.0

tirement of facilities in Winnipeg were made under the general direction of Walter M. Scott, Chairman of Commissioners, Greater Winnipeg Water District, and a member of the Committee on Survival and Retirement Ex-

perience With Water Works Facilities. H. Shand, Engineer of the Winnipeg Water District, and W. D. Hurst, City Engineer (at the time of the study, Engineer of Water Works), were in charge of abstracting the records.

SUMMARY OF INSTALLATIONS AND RETIREMENTS
WINNIPEG, MANITOBA

MAINS

3-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1942	199	199	0
TOTAL	199	199	0

4-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1882	2,021	634	1,387
1883	3,606	935	2,671
1884	8,105	3,587	4,518
1885	2,782	852	1,930
1886	312	312	0
1887	4,375	634	3,741
1888	13,276	3,642	9,634
1889	6,835	3,872	2,963
1890	1,790	609	1,181
1891	2,495	745	1,750
1892	2,427	352	2,075
1893	1,788	495	1,293
1894	2,287	0	2,287
1895	261	261	0
1899	18,065	11,421	6,644
1900	36,228	31,496	4,732
1901	7,643	5,777	1,866
1902	5,990	5,207	783
1903	7,187	6,152	1,035
1904	16,134	13,984	2,150
1905	32,546	28,501	4,045
1906	4,009	3,136	873
1907	6,375	5,097	1,278
1908	1,479	1,401	78
1909	1,046	1,046	0
1910	832	832	0
1912	219	219	0
1913	1,081	1,040	41
1914	212	212	0
1919	12	12	0
1923	610	610	0
1924	1,037	1,037	0
1925	1,047	1,047	0
1927	51	51	0
1929	11	11	0
1936	62	62	0
1939	25	25	0

4-IN. CAST-IRON UNLINED MAINS (contd.)

<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1941	666	666	0
1942	209	209	0
TOTAL	195,136	136,181	58,955

Retirements by Years

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1882	39	1914	1,204	1924	64	1938	
	80	1939					
1883	1,470	1924	1,201	1939			
1884	64	1906	567	1909	772	1911	
	569	1923	2,294	1924	252	1936	
1885	100	1907	20	1911	1,240	1930	
	570	1939					
1887	20	1912	3,068	1924	653	1927	
1888	222	1907	80	1911	2,761	1923	
	518	1924	398	1927	1,880	1929	
	1,686	1930	400	1934	1,088	1939	
	601	1940					
1889	28	1918	1,662	1922	502	1923	
	771	1924					
1890	66	1938	1,115	1939			
1891	940	1914	633	1923	170	1929	
	7	1936					
1892	1,329	1921	351	1923	395	1930	
1893	263	1922	80	1923	950	1939	
1894	2,075	1924	212	1939			
1899	253	1915	1,757	1922	247	1924	
	512	1928	1,170	1933	58	1937	
	2,647	1939					
1900	84	1904	1,795	1923	1,177	1924	
	128	1929	618	1935	46	1936	
	711	1939	173	1941			
1901	921	1935	945	1939			
1902	360	1929	403	1935	20	1939	
1903	232	1923	342	1928	65	1935	
	396	1939					
1904	39	1910	324	1926	332	1930	
	397	1932	1,058	1939			
1905	27	1913	329	1922	441	1930	
	266	1937	2,982	1939			
1906	64	1923	619	1924	190	1934	
1907	10	1909	330	1936	15	1937	
	923	1939					
1908	20	1913	58	1937			
1913	41	1929					

5-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Retirements by Years</i>				
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Year</i> <i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1883	1,790	0	1,790	1883	1,790	1924		
1886	1,677	1,677	0	1887	1,637	1927	1,553	1939
1887	4,143	953	3,190	1889	1,729	1922	1,090	1939
1888	1,959	1,959	0	1891	1,206	1939		
1889	2,819	0	2,819					
1891	1,737	531	1,206					
1893	650	650	0					
1942	0	0	0					
TOTAL	14,775	5,770	9,005					

6-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1882	10,814	9,075	1,739	1916	2,957	2,957	0
1883	2,610	2,045	565	1917	2,495	2,495	0
1884	436	0	436	1918	320	309	11
1887	1,152	663	489	1919	6,932	6,766	166
1888	8,808	7,486	1,322	1920	5,409	5,409	0
1889	978	329	649	1921	7,900	7,900	0
1890	1,827	48	1,779	1922	13,553	13,553	0
1891	1,869	1,542	327	1923	16,597	16,028	569
1892	1,368	330	1,038	1924	16,526	16,526	0
1895	114	114	0	1925	4,418	4,418	0
1896	360	360	0	1926	4,465	4,335	130
1899	44,696	39,114	5,582	1927	4,146	4,146	0
1900	24,142	22,731	1,411	1928	3,840	3,840	0
1901	25,687	24,064	1,623	1929	13,677	13,677	0
1902	38,074	37,237	837	1930	6,532	6,484	48
1903	23,549	21,079	2,470	1931	4,154	4,154	0
1904	38,737	37,625	1,112	1932	4,446	4,446	0
1905	113,233	112,025	1,208	1933	400	400	0
1906	59,083	59,083	0	1934	610	610	0
1907	90,434	88,905	1,529	1935	2,795	2,795	0
1908	30,242	30,242	0	1937	237	237	0
1909	32,462	31,693	769	1938	513	513	0
1910	51,334	50,896	438	1939	20,477	20,477	0
1911	56,268	56,257	11	1940	1,008	1,008	0
1912	40,641	40,484	157	1941	7,135	7,135	0
1913	55,078	55,078	0	1942	213	213	0
1914	41,765	41,705	60				
1915	4,456	4,456	0	TOTAL	951,972	925,497	26,475

Retirements by Years

<i>Year</i>				<i>Year</i>			
	<i>Installed</i>	<i>Feet</i>	<i>Year</i>		<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1882	1,739		1939	1888	52	1919	590 1934 148 1938
1883	565		1924		532	1939	
1884	436		1939	1889	649	1922	
1887	489		1939	1890	608	1907	150 1929 1,021 1939

SURVIVAL AND RETIREMENT

6-IN. CAST-IRON UNLINED MAINS (contd.)

Retirements by Years (contd.)

<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1891	66	1911	261	1939				1907	1,338	1922	20	1931	34	1932	
1892	888	1935	150	1940					5	1934	86	1936	46	1939	
1899	46	1921	514	1922	23	1927		1909	567	1924	202	1940			
	1,305	1929	251	1935	24	1936		1910	80	1931	358	1932			
	3,419	1939						1911	11	1924					
1900	709	1934	702	1939				1912	52	1914	105	1932			
1901	482	1905	619	1910	150	1919		1914	60	1924					
	372	1921						1918	11	1941					
1902	56	1910	304	1932	477	1941		1919	166	1924					
1903	21	1909	1,622	1935	364	1939		1923	569	1940					
	463	1942						1926	130	1939					
1904	650	1911	462	1939				1930	48	1940					
1905	142	1910	70	1913	174	1932									
	12	1933	810	1939											

8-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1882	13,119	2,451	10,668	1920	3,033	3,033	0
1883	2,028	0	2,028	1921	4,360	4,360	0
1887	1,492	569	923	1922	809	809	0
1889	3,988	1,266	2,722	1923	1,385	1,385	0
1899	15,342	14,820	522	1924	15,320	15,320	0
1900	11,543	11,310	233	1925	159	159	0
1901	2,940	195	2,745	1926	5,868	5,868	0
1902	7,787	7,787	0	1927	5,208	5,208	0
1903	2,282	2,282	0	1928	4,493	4,493	0
1904	6,129	5,792	337	1929	2,281	2,281	0
1905	6,591	6,591	0	1930	8,107	8,107	0
1906	5,936	5,279	657	1931	50	50	0
1907	1,753	1,753	0	1932	5,778	5,778	0
1908	15,152	15,152	0	1935	639	639	0
1909	7,951	7,951	0	1936	13	13	0
1910	10,559	10,548	11	1937	19	19	0
1911	11,216	11,216	0	1939	7,748	7,748	0
1912	14,904	14,894	10	1940	778	778	0
1913	20,390	20,390	0	1941	112	112	0
1914	9,049	9,049	0	1942	0	0	0
1915	1,473	1,473	0				
1916	1,968	1,968	0				
1919	4,283	4,283	0				
				TOTAL	244,035	223,179	20,856

Retirements by Years

Year						Year							
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1882	300	1904	3,634	1923	2,296	1937	1900	225	1921	8	1939		
	4,438	1939					1901	2,745	1935				
1883	2,028	1924					1904	107	1912	220	1935	10	1936
1887	725	1922	198	1938			1906	285	1911	372	1937		
1889	2,722	1938					1910	11	1937				
1899	425	1904	97	1913			1912	10	1936				

10-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1882	905	905	0	1923	5,354	5,354	0
1891	2,840	2,507	333	1924	1,699	1,699	0
1899	9,477	9,408	69	1925	1,099	1,099	0
1900	5,309	5,309	0	1926	3,124	3,124	0
1901	2,202	2,202	0	1927	1,032	1,032	0
1902	7,606	7,606	0	1928	719	719	0
1903	4,286	4,286	0	1929	1,586	1,586	0
1904	5,705	5,705	0	1930	2,306	2,306	0
1905	10,072	10,072	0	1931	3,399	3,399	0
1906	5,411	5,411	0	1932	739	739	0
1907	8,281	8,281	0	1933	175	175	0
1908	10,246	10,246	0	1935	540	540	0
1909	1,768	1,768	0	1936	143	143	0
1910	6,055	6,055	0	1937	2,298	2,298	0
1911	7,899	7,769	130	1938	201	201	0
1912	11,899	11,899	0	1939	616	616	0
1913	20,440	20,440	0	1942	21	21	0
1914	7,934	7,934	0	TOTAL			532
1915	3,829	3,829	0	<i>Retirements by Years</i>			
1916	1,384	1,384	0	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1917	1,138	1,138	0	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1919	1,106	1,106	0	1891	333	1926	
1920	2,000	2,000	0	1899	20	1919	49
1921	283	283	0	1911	130	1936	
1922	1,180	1,180	0				

12-IN. CAST-IRON UNLINED MAINS

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1882	2,675	0	2,675	1928	280	280	0
1899	5,768	5,684	84	1929	3,393	3,393	0
1901	2,248	2,248	0	1930	3,146	3,146	0
1902	1,577	1,577	0	1931	8	8	0
1903	1,137	1,137	0	1932	2,062	2,062	0
1904	557	557	0	1935	3,441	3,441	0
1905	2,110	2,058	52	1938	20	20	0
1906	2,501	2,493	8	1939	2,540	2,540	0
1907	8,176	8,093	83	1940	41	41	0
1908	11,184	11,134	50	1941	157	157	0
1909	7,976	7,887	89	1942	7	7	0
1910	3,282	3,167	115	TOTAL			3,458
1911	2,393	2,165	228	<i>Retirements by Years</i>			
1912	1,129	1,055	74	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1913	7,266	7,266	0	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1914	5,291	5,291	0	1882	170	1901	2,505
1915	2,380	2,380	0	1899	84	1904	
1916	736	736	0	1905	52	1932	
1917	1,245	1,245	0	1906	8	1941	
1919	2,083	2,083	0	1907	83	1922	
1920	345	345	0	1908	50	1925	
1921	811	811	0	1909	89	1922	
1922	1,679	1,679	0	1910	115	1918	
1925	3,620	3,620	0	1911	228	1919	
1926	865	865	0	1912	74	1922	
1927	555	555	0				

14-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1889	2,406	2,406	0
1899	6,548	6,548	0
1900	294	294	0
1902	1,718	1,718	0
1903	2,032	2,032	0
1905	6,361	6,316	45
1907	5,795	5,795	0
1908	1,706	1,706	0
1911	2,251	2,251	0
1913	1,259	1,259	0
1914	1,383	1,383	0
1919	44	44	0
1923	2,998	2,998	0
1924	1,241	1,241	0
1929	154	154	0
1930	3,081	3,081	0
1932	9	9	0
1939	934	934	0
1941	54	54	0
1942	0	0	0
TOTAL	40,268	40,223	45

Retirements by Years

Year	Feet	
Installed	Feet	Year
1905	45	1919

16-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1899	5,126	5,126	0
1902	213	213	0
1905	1,935	1,935	0
1906	2,914	2,914	0
1907	5,872	5,872	0
1908	1,446	1,446	0
1909	772	772	0
1939	590	590	0
1942	0	0	0
TOTAL	18,868	18,868	0

18-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1899	1,863	1,863	0
1905	5,236	4,219	1,017
1906	6,442	6,346	96
1907	579	579	0
1908	257	257	0

18-IN. CAST-IRON UNLINED MAINS (contd)

Year	Feet		
Installed	Installed	In Service	Retired
1909	3,380	3,380	0
1911	2,081	2,081	0
1912	1,000	1,000	0
1919	7,172	7,172	0
1930	11,356	11,356	0
1932	295	295	0
1938	35	35	0
1939	54	54	0
1942	0	0	0
TOTAL	39,750	38,637	1,113

Retirements by Years

Year	Feet		Year
Installed	Feet	Year	Feet
1905	847	1910	170
1906	96	1941	

20-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1899	4,001	3,853	148
1919	17	17	0
1940	182	182	0
1942	0	0	0
TOTAL	4,200	4,052	148

Retirements by Years

Year	Feet		Year
Installed	Feet	Year	Feet
1899	148	1940	

24-IN. CAST-IRON UNLINED MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1919	11	11	0
1942	0	0	0
TOTAL	11	11	0

6-IN. ASBESTOS-CEMENT MAINS

Year	Feet		
Installed	Installed	In Service	Retired
1940	571	571	0
1942	0	0	0
TOTAL	571	571	0

10-IN. ASBESTOS-CEMENT MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1937	935	935	0
1938	2,703	2,703	0
1939	5,216	5,216	0
1942	0	0	0
TOTAL	8,854	8,854	0

14-IN. ASBESTOS-CEMENT MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1932	431	431	0
1942	0	0	0
TOTAL	431	431	0

18-IN. ASBESTOS-CEMENT MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1932	752	752	0
1939	107	107	0
1942	0	0	0
TOTAL	859	859	0

10-IN. CAST-IRON FLEXIBLE JOINT MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1904	314	314	0
1908	525	525	0
1942	0	0	0
TOTAL	839	839	0

12-IN. CAST-IRON FLEXIBLE JOINT MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	782	782	0
1942	0	0	0
TOTAL	782	782	0

18-IN. VICTAULIC UNLINED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1939	113	113	0
1942	0	0	0
TOTAL	113	113	0

24-IN. CONCRETE MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1938	3,899	3,899	0
1942	0	0	0
TOTAL	3,899	3,899	0

36-IN. STEEL CONCRETE COVERED MAINS

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1919	1,200	1,200	0
1942	0	0	0
TOTAL	1,200	1,200	0

METERS

 $\frac{5}{8}$ -IN. DISC METERS

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1900	1	0	1
1901	1	0	1
1902	81	0	81
1904	115	0	115
1906	203	104	99
1907	6	0	6
1908	4	2	2
1909	999	320	679
1910	3	1	2
1911	2	1	1

Year	Number		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	7	1	6
1913	54	3	51
1914	3	0	3
1915	21	5	16
1916	14	6	8
1917	4	1	3
1918	7	4	3
1919	7	3	4
1920	10	3	7
1921	6	2	4

SURVIVAL AND RETIREMENT

½-IN. DISC METERS (contd.)

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1922	6	1	5	1936	6	6	0
1923	7	3	4	1937	1	1	0
1924	5	2	3	1938	1	1	0
1925	5	2	3	1939	4	4	0
1926	6	3	3	1940	4	4	0
1927	2	1	1	1941	68	68	0
1928	2	0	2	1942	356	356	0
1929	4	0	4				
1930	10	3	7	SUBTOTAL	2,056	924	1,132
1931	1	1	0	Unknown	43	3	40
1933	5	2	3				
1934	12	7	5	TOTAL	2,099	927	1,172
1935	3	3	0				

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1900	1	1900					1909	37	1940	12	1941	15	1942
1901	1	1908					1910	1	1925	1	1936		
1902	1	1904	7	1906	37	1907	1911	1	1922				
	7	1908	12	1909	2	1910	1912	1	1915	1	1918	1	1919
	1	1911	1	1912	4	1913		1	1922	1	1923	1	1941
	3	1914	2	1915	2	1918	1913	1	1914	14	1915	12	1916
	1	1929	1	1930				4	1917	2	1918	2	1919
1904	1	1904	2	1905	8	1906		2	1920	2	1922	1	1925
	22	1907	7	1908	5	1909		1	1926	1	1928	1	1929
	5	1910	4	1911	6	1912		2	1932	1	1933	1	1936
	12	1913	13	1914	9	1915		3	1939	1	1941		
	3	1916	5	1917	1	1919	1914	2	1934	1	1935		
	1	1922	1	1926	1	1930	1915	2	1923	1	1926	1	1929
	3	1931	4	1932	1	1933		2	1934	1	1938	9	1940
	1	1935					1916	1	1919	1	1920	1	1924
1906	2	1907	1	1908	2	1909		1	1934	1	1938	3	1939
	3	1910	3	1911	2	1912	1917	1	1931	1	1936	1	1937
	1	1914	2	1915	1	1916	1918	1	1920	1	1934	1	1937
	2	1917	2	1918	4	1919	1919	1	1919	1	1920	1	1928
	3	1920	3	1921	1	1922		1	1940				
	1	1923	1	1924	1	1925	1920	2	1921	1	1924	3	1933
	3	1926	4	1930	5	1931		1	1934				
	6	1932	15	1933	2	1934	1921	1	1925	1	1934	1	1936
	5	1935	7	1936	2	1937		1	1939				
	4	1938	4	1939	5	1940	1922	3	1933	2	1935		
	2	1942					1923	2	1933	1	1937	1	1939
1907	4	1907	1	1908	1	1909	1924	2	1935	1	1940		
1908	1	1913	1	1914			1925	1	1930	1	1932	1	1939
1909	3	1910	1	1911	4	1912	1926	1	1929	2	1933		
	4	1913	4	1914	8	1915	1927	1	1929				
	15	1916	6	1917	6	1918	1928	1	1933	1	1940		
	5	1919	1	1920	2	1921	1929	2	1932	1	1933	1	1941
	5	1922	7	1923	1	1924	1930	1	1931	2	1933	1	1934
	2	1925	2	1926	1	1927		1	1936	1	1937	1	1940
	4	1928	23	1929	30	1930	1933	1	1939	2	1940		
	41	1931	55	1932	62	1933	1934	1	1935	2	1936	1	1937
	68	1934	54	1935	58	1936		1	1939				
	40	1937	50	1938	53	1939							

$\frac{1}{2}$ -IN. DISC METERS

Year Installed	Number			Retirements by Years						
	Installed	In Service	Retired	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1901	1	0	1	1901	1	1906				
1902	8	0	8	1902	2	1906	2	1907	1	1909
1934	1	1	0		1	1910	1	1911	1	1912
1939	3	3	0							
1940	10	10	0							
1941	7	7	0							
1942	21	21	0							
SUBTOTAL	51	42	9							
Unknown	3	2	1							
TOTAL	54	44	10							

1-IN. DISC METERS

Year Installed	Number			Retirements by Years						
	Installed	In Service	Retired	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1902	1	0	1	1902	1	1914				
1911	22	15	7	1911	2	1911	2	1925	1	1927
1912	47	21	26		2	1938				
1925	1	1	0	1912	1	1923	3	1925	3	1926
1934	4	3	1		2	1927	5	1928	3	1929
1938	2	2	0		1	1930	2	1933	1	1935
1939	16	16	0		4	1938	1	1940		
1940	17	17	0	1934	1	1940				
1941	7	7	0							
1942	0	0	0							
SUBTOTAL	117	82	35							
Unknown	19	0	19							
TOTAL	136	82	54							

 $1\frac{1}{2}$ -IN. DISC METERS

Year Installed	Number			Retirements by Years						
	Installed	In Service	Retired	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1911	5	3	2	1911	1	1925	1	1933		
1912	4	1	3	1912	1	1923	1	1933	1	1938
1914	1	0	1	1914	1	1924				
1916	3	1	2	1916	1	1928	1	1940		
1934	1	1	0							
1939	3	3	0							
1940	5	5	0							
1941	4	4	0							
1942	4	4	0							
SUBTOTAL	30	22	8							
Unknown	24	0	24							
TOTAL	54	22	32							

2-IN. DISC METERS

Year Installed	Number			Retirements by Years						
	Installed	In Service	Retired	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1900	1	0	1	1900	1	1907				
1911	9	3	6	1911	1	1912	1	1921	3	1934
1912	14	1	13		1	1941				
1913	8	1	7	1912	1	1917	1	1922	2	1924
1914	8	2	6		6	1934	1	1937	2	1938
1915	2	0	2	1913	1	1922	1	1923	1	1924
1917	1	1	0		2	1925	2	1931		
1921	1	1	0	1914	1	1923	3	1924	1	1925
1934	1	1	0		1	1927				
1938	1	1	0	1915	1	1923	1	1924		
1940	1	1	0							
1941	7	7	0							
1942	2	2	0							
	—	—	—							
SUBTOTAL	56	21	35							
Unknown	3	0	3							
	—	—	—							
TOTAL	59	21	38							

3-IN. DISC METERS

Year Installed	Number			Retirements by Years						
	Installed	In Service	Retired	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1901	3	0	3	1901	1	1911	1	1912	1	1916
1913	4	2	2	1913	2	1941				
1935	1	1	0							
1942	0	0	0							
	—	—	—							
SUBTOTAL	8	3	5							
Unknown	1	0	1							
	—	—	—							
TOTAL	9	3	6							

 $\frac{1}{2}$ -IN. PISTON METERS

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1899	909	893	16	1915	632	611	21
1900	490	482	8	1916	29	24	5
1901	115	115	0	1917	246	239	7
1902	35	35	0	1918	208	192	16
1903	842	824	18	1919	99	96	3
1904	1,447	1,399	48	1920	160	152	8
1905	1,336	1,305	31	1921	449	441	8
1906	3,113	2,859	254	1922	605	586	19
1907	1,502	1,248	254	1923	1,108	1,083	25
1908	815	808	7	1924	663	649	14
1909	3,760	3,541	219	1925	331	329	2
1910	2,569	2,443	126	1926	673	667	6
1911	2,553	2,467	86	1927	681	677	4
1912	2,438	2,354	84	1928	1,005	1,002	3
1913	3,271	3,216	55	1929	809	804	5
1914	2,771	2,431	40	1930	777	774	3

$\frac{3}{4}$ -IN PISTON METERS (contd.)

Year Installed	Number			Year Installed	Number		
	Installed	In Service	Retired		Installed	In Service	Retired
1931	463	462	1	1940	23	23	0
1932	356	355	1	1941	222	222	0
1933	80	79	1	1942	77	77	0
1934	84	82	2				
1935	62	61	1	SUBTOTAL	37,646	36,245	1,401
1936	90	90	0	Unknown	291	5	286
1937	26	26	0				
1938	11	11	0	TOTAL	37,937	36,250	1,687
1939	11	11	0				

Retirements by Years

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year Installed	Num- ber	Year	Num- ber	Year
1899	1	1907	1	1912	1	1924	1907	4	1917	2	1918
	2	1925	4	1928	3	1929		6	1920	1	1921
	1	1930	1	1932	1	1938		6	1923	5	1924
	1	1940						1	1926	5	1927
1900	1	1906	1	1912	2	1922		3	1929	5	1930
	1	1926	1	1928	1	1929		3	1932	9	1933
	1	1933						17	1935	16	1936
1903	1	1913	1	1923	1	1924		1	1938	3	1939
	2	1929	2	1930	1	1932		4	1941	6	1942
	1	1933	2	1934	2	1935	1908	1	1920	1	1935
	1	1936	1	1938	1	1939		1	1938	1	1939
	1	1940	1	1941			1909	1	1909	1	1910
1904	1	1904	3	1910	1	1911		4	1912	3	1913
	9	1912	1	1916	1	1917		2	1915	7	1916
	1	1918	2	1921	2	1922		5	1918	2	1919
	1	1924	2	1925	1	1927		7	1921	8	1922
	3	1928	3	1929	1	1932		12	1924	5	1925
	4	1934	1	1935	2	1937		7	1927	8	1928
	1	1938	1	1939	2	1940		3	1930	4	1931
	3	1941	2	1942				8	1933	14	1934
1905	1	1910	4	1912	2	1914		15	1936	8	1937
	1	1917	1	1925	1	1927		1	1939	5	1940
	3	1928	1	1929	1	1930		11	1942		
	2	1933	4	1934	4	1935	1910	10	1911	6	1912
	2	1936	3	1940	1	1941		3	1914	6	1915
1906	1	1908	8	1909	7	1910		2	1917	4	1918
	11	1911	23	1912	4	1913		1	1920	4	1921
	3	1914	5	1915	9	1916		10	1923	6	1924
	5	1917	5	1918	5	1919		2	1926	6	1928
	1	1920	2	1921	2	1922		5	1930	5	1931
	7	1923	10	1924	10	1925		3	1933	11	1934
	6	1926	3	1927	8	1928		8	1936	1	1937
	7	1929	6	1930	1	1931		7	1942		
	6	1932	5	1933	22	1934	1911	6	1911	11	1912
	13	1935	32	1936	8	1937		2	1914	3	1915
	4	1938	7	1940	7	1941		2	1918	2	1919
	1	1942						2	1921	5	1922
1907	1	1908	15	1909	17	1910		3	1924	1	1925
	25	1911	12	1912	10	1913		2	1927	1	1928
	15	1914	15	1915	3	1916		1	1930	4	1932

SURVIVAL AND RETIREMENT

 $\frac{1}{2}$ -IN. PISTON METERS (contd.)

Retirements by Years (contd.)

Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year	Year Installed	Num- ber	Year	Num- ber	Year	Num- ber	Year
1911	3	1934	1	1935	4	1936	1918	1	1924	1	1925	1	1926
	3	1939	4	1940	1	1941		2	1927	1	1929	1	1930
	9	1942						1	1931	1	1934	2	1936
1912	2	1912	2	1913	1	1914		1	1942				
	11	1915	12	1916	7	1917	1919	1	1921	1	1934	1	1942
	3	1918	3	1919	3	1921	1920	1	1922	1	1923	1	1928
	2	1923	2	1924	2	1925		1	1931	1	1934	1	1936
	2	1926	2	1927	2	1928		2	1942				
	2	1929	1	1931	1	1932	1921	1	1922	1	1924	1	1925
	3	1933	4	1934	3	1935		1	1926	1	1929	1	1936
	3	1936	1	1937	3	1938		1	1941	1	1942		
	3	1939	2	1941	2	1942	1922	1	1924	3	1927	2	1928
1913	2	1913	1	1915	3	1917		1	1930	2	1931	1	1934
	4	1918	4	1919	4	1920		2	1935	1	1941	6	1942
	3	1921	2	1922	3	1923	1923	1	1924	2	1925	1	1926
	2	1924	1	1925	1	1926		3	1927	1	1928	1	1929
	1	1927	4	1928	3	1929		1	1930	1	1933	1	1935
	2	1930	2	1932	4	1934		2	1936	1	1938	3	1941
	2	1935	1	1936	1	1938		7	1942				
	1	1940	4	1942			1924	3	1925	1	1926	2	1927
1914	1	1914	1	1917	1	1918		1	1928	1	1929	1	1931
	3	1919	2	1920	1	1921		1	1932	2	1935	1	1941
	2	1922	1	1923	1	1924		1	1942				
	1	1925	1	1926	5	1928	1925	1	1932	1	1937		
	1	1929	3	1932	2	1933	1926	1	1929	2	1930	1	1936
	6	1934	3	1936	1	1937		2	1942				
	1	1940	2	1941	1	1942	1927	2	1933	1	1940	1	1941
1915	1	1917	1	1920	7	1923	1928	1	1936	1	1938	1	1940
	1	1924	1	1925	1	1926	1929	1	1929	1	1933	1	1936
	1	1927	1	1928	2	1930		1	1938	1	1940		
	1	1933	2	1934	1	1935	1930	1	1934	1	1935	1	1942
	1	1938					1931	1	1936				
1916	1	1920	1	1922	1	1935	1932	1	1934				
	2	1942					1933	1	1934				
1917	1	1919	1	1925	2	1930	1934	2	1937				
	1	1931	1	1941	1	1942	1935	1	1936				
1918	1	1918	1	1921	2	1923							

 $\frac{3}{4}$ -IN. PISTON METERS

Year	Number			Year	Number		
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1899	218	216	2	1909	70	70	0
1900	216	214	2	1910	59	58	1
1901	60	60	0	1911	46	42	4
1902	33	33	0	1912	50	49	1
1903	227	224	3	1913	82	77	5
1904	44	43	1	1914	39	39	0
1905	54	54	0	1915	22	21	1
1906	71	71	0	1916	4	3	1
1907	31	30	1	1917	1	1	0
1908	58	57	1	1918	5	4	1

1-IN. PISTON METERS (contd.)

Retirements by Years

<i>Year Installed</i>	<i>Num-ber</i>	<i>Year</i>	<i>Num-ber</i>	<i>Year</i>	<i>Num-ber</i>	<i>Year</i>	<i>Year Installed</i>	<i>Num-ber</i>	<i>Year</i>	<i>Num-ber</i>	<i>Year</i>	<i>Num-ber</i>	<i>Year</i>
1901	1	1906	1	1921	1	1932	1910	1	1911	1	1913	1	1922
	1	1938						1	1940				
1903	1	1932					1911	1	1934				
1905	1	1934					1922	1	1930				
1907	1	1934											

1½-IN. PISTON METERS

<i>Year Installed</i>	<i>Number</i>			<i>Year Installed</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1899	2	2	0	1924	7	7	0
1900	4	4	0	1925	7	7	0
1901	9	9	0	1926	13	12	1
1902	12	11	1	1927	15	15	0
1903	2	2	0	1928	24	24	0
1904	7	7	0	1929	23	23	0
1905	11	11	0	1930	12	12	0
1906	11	11	0	1931	9	9	0
1907	10	10	0	1932	4	4	0
1908	7	7	0	1933	3	3	0
1909	5	5	0	1935	1	1	0
1910	13	11	2	1936	2	2	0
1912	5	5	0	1937	1	1	0
1913	3	3	0	1942	0	0	0
1914	47	45	2				
1915	11	11	0	TOTAL	322	316	6
1916	2	2	0				
1917	4	4	0				
1918	8	8	0				
1919	5	5	0				
1920	6	6	0				
1921	3	3	0				
1922	4	4	0				
1923	10	10	0				

<i>Retirements by Years</i>				
<i>Year Installed</i>	<i>Number</i>	<i>Year</i>	<i>Number</i>	<i>Year</i>
1902	1	1937		
1910	1	1935	1	1937
1914	2	1936		
1926	1	1929		

2-IN. PISTON METERS

<i>Year Installed</i>	<i>Number</i>			<i>Year Installed</i>	<i>Number</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1899	1	1	0	1912	2	2	0
1900	19	18	1	1913	5	5	0
1901	4	4	0	1914	3	3	0
1902	7	7	0	1915	6	5	1
1904	9	9	0	1916	8	8	0
1905	10	10	0	1917	5	5	0
1906	4	3	1	1918	7	7	0
1907	7	7	0	1919	1	1	0
1908	2	2	0	1920	3	2	1
1909	3	2	1	1921	5	5	0
1910	12	11	1	1922	10	10	0

2-IN. PISTON METERS (contd.)

Year				Year			
Number				Number			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1923	9	9	0	1937	1	1	0
1924	5	5	0	1938	1	1	0
1925	7	6	1	1939	3	3	0
1926	8	7	1	1940	5	5	0
1927	5	4	1	1942	0	0	0
1928	8	8	0				
1929	8	7	1	SUBTOTAL	214	203	11
1930	9	8	1	Unknown	1	0	1
1931	9	9	0				
1932	2	2	0	TOTAL	215	203	12
1933	1	1	0				

Retirements by Years

Year			Year		
Number			Number		
Installed	Number	Year	Installed	Number	Year
1900	1	1923	1925	1	1926
1906	1	1938	1926	1	1926
1909	1	1920	1927	1	1927
1910	1	1932	1929	1	1930
1915	1	1937	1930	1	1930
1920	1	1929			

3-IN. PISTON METERS

Year			
Number			
Installed	Installed	In Service	Retired
1901	3	3	0
1906	1	1	0
1911	2	1	1
1912	5	5	0
1926	1	1	0
1942	0	0	0
SUBTOTAL	12	11	1
Unknown	1	0	1
TOTAL	13	11	2

Retirements by Years

Year		
Number		
Installed	Number	Year
1911	1	1926

4-IN. PISTON METERS

Year			
Number			
Installed	Installed	In Service	Retired
1912	2	2	0
1942	0	0	0
TOTAL	2	2	0

2-IN. CURRENT METERS

Year			
Number			
Installed	Installed	In Service	Retired
1905	3	0	3
1919	1	0	1
1942	0	0	0
TOTAL	4	0	4

Retirements by Years

Year				
Number				
Installed	Number	Year	Number	Year
1905	1	1919	2	1934
1919	1	1920		

3-IN. CURRENT METERS

Year			
Number			
Installed	Installed	In Service	Retired
1903	1	1	0
1904	1	1	0
1908	3	3	0
1909	2	2	0
1910	1	1	0
1911	1	1	0
1912	3	2	1
1914	3	2	1

3-IN. CURRENT METERS (contd.)

Year	Number		
Installed	Installed	In Service	Retired
1915	3	3	0
1942	0	0	0
	—	—	—
SUBTOTAL	18	16	2
Unknown	1	0	1
	—	—	—
TOTAL	19	16	3

Retirements by Years

Year	Number		Year
Installed	Number	Year	
1912	1	1919	
1914	1	1934	

4-IN. CURRENT METERS

Year	Number		
Installed	Installed	In Service	Retired
1906	2	1	1
1908	1	1	0
1914	1	1	0
1915	2	2	0
1936	1	1	0
1942	0	0	0
	—	—	—
SUBTOTAL	7	6	1
Unknown	1	0	1
	—	—	—
TOTAL	8	6	2

Retirements by Years

Year	Number		Year
Installed	Number	Year	
1906	1	1935	

6-IN. CURRENT METERS

Year	Number		
Installed	Installed	In Service	Retired
1926	1	1	0
1942	0	0	0
	—	—	—
TOTAL	1	1	0

3-IN. COMPOUND METERS

Year	Number		
Installed	Installed	In Service	Retired
1913	1	1	0
1915	5	5	0
1916	2	2	0
1917	1	1	0
1918	2	2	0
1919	1	1	0

3-IN. COMPOUND METERS (contd.)

Year	Number		
Installed	Installed	In Service	Retired
1920	5	5	0
1921	1	1	0
1922	5	5	0
1923	1	1	0
1924	3	3	0
1925	3	3	0
1926	6	6	0
1929	2	2	0
1930	3	3	0
1931	1	1	0
1932	1	1	0
1933	1	1	0
1934	1	1	0
1935	3	3	0
1936	1	1	0
1938	1	1	0
1939	1	1	0
1940	4	4	0
1942	0	0	0
	—	—	—
TOTAL	55	55	0

4-IN. COMPOUND METERS

Year	Number		
Installed	Installed	In Service	Retired
1913	1	1	0
1916	2	2	0
1918	1	1	0
1919	1	1	0
1920	1	1	0
1924	3	3	0
1926	2	2	0
1928	2	2	0
1929	1	1	0
1930	2	2	0
1931	4	4	0
1932	1	1	0
1938	1	1	0
1941	1	1	0
1942	0	0	0
	—	—	—
TOTAL	23	23	0

6-IN. COMPOUND METERS

Year	Number		
Installed	Installed	In Service	Retired
1920	1	1	0
1925	1	1	0
1928	1	1	0
1934	1	1	0
1942	0	0	0
	—	—	—
TOTAL	4	4	0

SERVICES

 $\frac{1}{2}$ -IN. GALVANIZED-IRON SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1882	124	0	124
1883	32	0	32
1942	0	0	0
	—	—	—
SUBTOTAL	156	0	156
Unknown	103	0	103
	—	—	—
TOTAL	259	0	259

Retirements by Years

Year	Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1882	29	1895	47	1901	47	1916		
1883	32	1901						

 $\frac{3}{8}$ -IN. GALVANIZED-IRON SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1882	33	0	33
1942	0	0	0
	—	—	—
TOTAL	33	0	33

Retirements by Years

Year	Installed	Feet	Year	Feet
1882	33	1901		

 $\frac{1}{2}$ -IN. GALVANIZED-IRON SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1882	509	0	509
1883	292	0	292
1884	689	0	689
1942	0	0	0
	—	—	—
SUBTOTAL	1,490	0	1,490
Unknown	633	0	633
	—	—	—
TOTAL	2,123	0	2,123

Retirements by Years

Year	Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1882	30	1891	105	1895	66	1898		
	76	1900	48	1901	20	1904		
	103	1905	20	1908	41	1909		
1883	40	1894	103	1900	18	1903		
	102	1905	29	1906				

 $\frac{3}{4}$ -IN. GALVANIZED-IRON SERVICES (contd.)

Retirements by Years (contd.)

Year	Installed	Feet	Year	Feet	Year	Feet
1884	40	1893	114	1894	161	1895
	49	1896	46	1897	45	1898
	86	1900	102	1906	46	1912

1-IN. GALVANIZED-IRON SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1882	34	0	34
1883	122	0	122
1884	243	0	243
1942	0	0	0
	—	—	—
SUBTOTAL	399	0	399
Unknown	256	0	256
	—	—	—
TOTAL	655	0	655

Retirements by Years

Year	Installed	Feet	Year	Feet	Year	Feet	Year	Feet
1882	34	1896						
1883	42	1886	33	1900	47	1904		
1884	105	1891	138	1894				

1 $\frac{1}{2}$ -IN. GALVANIZED-IRON SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
Unknown	28	0	28
	—	—	—
TOTAL	28	0	28

1 $\frac{3}{4}$ -IN. GALVANIZED-IRON SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1882	98	0	98
1942	0	0	0
	—	—	—
SUBTOTAL	98	0	98
Unknown	34	0	34
	—	—	—
TOTAL	132	0	132

Retirements by Years

Year	Installed	Feet	Year	Feet
1882	98	1903		

$\frac{1}{2}$ -IN. WROUGHT-IRON SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1884	46	0	46
1886	205	0	205
1887	1,065	0	1,065
1888	1,464	0	1,464
1889	933	0	933
1890	268	0	268
1891	451	0	451
1892	322	0	322
1893	436	0	436
1942	0	0	0
SUBTOTAL	5,190	0	5,190
Unknown	827	0	827
TOTAL	6,017	0	6,017

Retirements by Years

Year	Feet		Year	Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1884	46	1895	1888	46	1915
1886	73	1894	1889	20	1889
1887	37	1891	45	1893	145
	136	1895	65	1897	37
	138	1899	135	1900	318
	46	1902	46	1903	92
	46	1915	40	1906	46
1888	20	1889	84	1909	18
	45	1893	33	1893	103
	65	1897	79	1896	46
	135	1900	88	1899	114
	46	1903	54	1902	129
	40	1906	30	1897	16
	84	1909	102	1901	20
1889	33	1893	20	1909	20
	79	1896	27	1896	20
	88	1899	20	1899	20
	54	1902	80	1903	16
1890	30	1897	12	1907	20
	102	1901	20	1898	92
	20	1909	20	1900	92
1891	27	1896	20	1903	16
	20	1899	20	1910	32
	80	1903	20	1907	20
	12	1907	20	1898	35
1892	20	1898	76	1903	43
	76	1903	20	1907	88
	20	1907	1892	20	1901
1893	175	1900	59	1903	20
	59	1903	20	1904	15
	20	1906	20	1907	112

 $\frac{3}{8}$ -IN. WROUGHT-IRON SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1888	112	0	112
1942	0	0	0
TOTAL	112	0	112

Retirements by Years

Year	Feet		Year	Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1888	20	1901	1888	20	1901
			1912		

 $\frac{1}{2}$ -IN. WROUGHT-IRON SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	97	0	97
1886	310	0	310
1887	888	0	888
1888	1,907	0	1,907
1889	2,682	0	2,682
1890	2,381	0	2,381
1891	2,802	0	2,802
1892	2,289	0	2,289
1893	3,567	0	3,567
1894	46	0	46
1896	40	0	40
1898	130	0	130
1942	0	0	0
SUBTOTAL	17,139	0	17,139
Unknown	2,047	0	2,047
TOTAL	19,186	0	19,186

Retirements by Years

Year	Feet		Year	Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1885	45	1890	1886	46	1886
1886	46	1886	18	1895	24
	18	1895	42	1903	
	42	1903	7	1891	110
1887	7	1891	56	1896	60
	56	1896	111	1899	109
	111	1899	82	1904	46
	82	1904	20	1909	
	20	1909	20	1890	44
1888	20	1890	66	1894	130
	66	1894	198	1898	237
	198	1898	168	1901	46
	168	1901			

$\frac{3}{4}$ -IN. WROUGHT-IRON SERVICES (contd.)*Retirements by Years (contd.)*

Year	Feet		
Installed	Installed	In Service	Retired
1888	40 1905	46 1906	192 1907
1889	136 1894	124 1895	66 1896
	196 1897	112 1898	320 1899
	343 1800	209 1901	237 1902
	116 1903	129 1904	99 1905
	223 1906	184 1907	64 1908
	20 1909	38 1911	20 1922
	46 1927		
1890	92 1894	47 1896	92 1897
	154 1898	20 1899	388 1900
	514 1901	137 1902	244 1903
	94 1905	88 1906	258 1907
	207 1908	46 1914	
1891	35 1895	265 1896	193 1897
	46 1898	279 1899	619 1900
	257 1901	142 1902	168 1903
	20 1904	82 1905	284 1906
	92 1907	40 1908	112 1909
	18 1910	46 1912	58 1914
	46 1915		
1892	21 1895	39 1897	46 1898
	226 1899	452 1900	
	351 1901	219 1902	188 1903
	20 1904	66 1905	201 1906
	172 1907	106 1908	112 1909
	52 1910	18 1924	
1893	46 1896	67 1897	96 1898
	108 1899	419 1900	555 1901
	262 1902	209 1903	248 1904
	40 1905	426 1906	663 1907
	92 1908	142 1909	46 1910
	92 1914	10 1915	46 1926
1894	46 1903		
1896	40 1905		
1898	130 1904		

1-IN. WROUGHT-IRON SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1884	430	0	430
1885	306	0	306
1886	263	0	263
1887	116	0	116
1888	229	0	229
1889	417	0	417
1890	307	0	307
1891	183	0	183

1-IN. WROUGHT-IRON SERVICES (contd.)

Year	Feet		
Installed	Installed	In Service	Retired
1892	343	0	343
1893	277	0	277
1896	20	0	20
1898	53	0	53
1942	0	0	0
SUBTOTAL	2,944	0	2,944
Unknown	1,165	0	1,165
TOTAL	4,109	0	4,109

Retirements by Years

Year	Feet		Year	Feet	
Installed	Feet	Year	Feet	Year	Feet
1884	97	1893	24	1897	47
	107	1900	155	1901	
1885	47	1896	20	1898	29
	180	1900	30	1901	
1886	27	1888	15	1895	136
	46	1900	39	1905	
1887	36	1894	80	1902	
1888	46	1897	56	1901	18
	109	1908			
1889	46	1896	66	1898	126
	41	1901	46	1903	46
	46	1906			
1890	50	1897	14	1900	46
	46	1906	101	1908	50
1891	98	1897	29	1901	29
	27	1906			
1892	20	1898	98	1900	46
	46	1902	113	1906	20
1893	103	1899	128	1901	46
1896	20	1903			
1898	53	1899			

 $1\frac{1}{4}$ -IN. WROUGHT-IRON SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1895	163	0	163
1942	0	0	0
TOTAL	163	0	163

Retirement by Years

Year	Feet	Year
Installed	Feet	Year
1895	163	1900

1½-IN. WROUGHT-IRON SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1886	45	0	45
1893	18	0	18
1895	183	0	183
1896	20	0	20
1942	0	0	0
SUBTOTAL	266	0	266
Unknown	20	0	20
TOTAL	286	0	286

Retirements by Years

Year	Feet		Year	Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1886	45	1896			
1893	18	1899			
1895	136	1899	27	1912	20
1896	20	1913			

2-IN. WROUGHT-IRON SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1884	211	0	211
1885	20	0	20
1886	24	0	24
1889	31	0	31
1890	49	0	49
1892	46	0	46
1893	46	0	46
1895	163	0	163
1900	15	0	15
1942	0	0	0
SUBTOTAL	605	0	605
Unknown	46	0	46
TOTAL	651	0	651

Retirements by Years

Year	Feet		Year	Feet	
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1884	86	1898	102	1901	23
1885	20	1897			
1886	24	1901			
1889	31	1896			
1890	49	1910			
1892	46	1906			
1893	46	1903			
1895	163	1909			
1900	15	1904			

2½-IN. WROUGHT-IRON SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	46	0	46
1895	20	0	20
1942	0	0	0
SUBTOTAL	66	0	66
Unknown	57	0	57
TOTAL	123	0	123

Retirements by Years

Year	Feet	Year	Feet
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1885	46	1898	
1895	20	1908	

3-IN. WROUGHT-IRON SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1885	133	0	133
1897	20	0	20
1942	0	0	0
TOTAL	153	0	153

Retirements by Years

Year	Feet	Year	Feet
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1885	105	1902	28
1897	20	1931	

¼-IN. COPPER SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1925	1,122	1,112	0
1926	14	14	0
1927	5,054	5,054	0
1928	8,095	8,095	0
1929	19,479	19,413	66
1930	14,455	14,337	118
1931	11,146	11,036	110
1932	6,591	6,405	186
1933	5,470	5,418	52
1934	3,597	3,477	120
1935	1,242	1,242	0
1936	727	727	0
1937	143	143	0
1938	48	48	0
1939	285	285	0

$\frac{1}{2}$ -IN. COPPER SERVICES (contd.)

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1940	58	58	0
1941	30	30	0
1942	0	0	0
SUBTOTAL	77,556	76,904	652
Unknown	69	69	0
TOTAL	77,625	76,973	652

Retirements by Years

Year	Feet		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1929	52	1931	14
1930	14	1932	52
1931	40	1933	18
1932	18	1939	52
	20	1940	96
	52	1932	52
1933	52	1933	96
1934	104	1942	16

 $\frac{1}{4}$ -IN. COPPER SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	1,002	1,002	0
1928	3,880	3,834	46
1929	3,626	3,564	62
1930	2,120	2,120	0
1931	1,643	1,633	10
1932	996	996	0
1933	1,449	1,449	0
1934	1,690	1,676	14
1935	802	802	0
1936	122	122	0
1937	10	10	0
1938	158	158	0
1939	95	95	0
1940	66	66	0
1942	0	0	0
SUBTOTAL	17,659	17,527	132
Unknown	106	106	0
TOTAL	17,765	17,633	132

Retirements by Years

Year	Feet		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1928	46	1941	
1929	46	1930	16
1931	10	1936	
1934	14	1940	

 $\frac{3}{4}$ -IN. COPPER SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	492	492	0
1928	1,017	933	84
1929	2,177	2,125	52
1930	1,643	1,643	0
1931	2,500	2,500	0
1932	1,242	1,192	50
1933	1,566	1,539	27
1934	1,359	1,343	16
1935	4,446	4,330	116
1936	7,627	7,565	62
1937	11,688	11,688	0
1938	11,440	11,440	0
1939	13,124	13,124	0
1940	18,171	18,171	0
1941	15,409	15,409	0
1942	0	0	0
SUBTOTAL	93,901	93,494	407
Unknown	74	74	0
TOTAL	93,975	93,568	407

Retirements by Years

Year	Feet		
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>
1928	14	1928	14
1929	52	1929	56
1932	50	1931	
1933	27	1938	
1934	16	1934	
1935	116	1942	
1936	52	1936	10

1-IN. COPPER SERVICES

Year	Feet		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1927	379	359	20
1928	1,182	1,130	52
1929	2,142	2,142	0
1930	911	873	38
1931	1,130	1,114	16
1932	400	400	0
1933	594	582	12
1934	324	324	0
1935	429	429	0
1936	676	676	0
1937	591	425	166
1938	1,153	1,153	0
1939	2,556	2,556	0
1940	867	867	0
1941	1,498	1,498	0
1942	0	0	0
TOTAL	14,832	14,528	304

1-IN. COPPER SERVICES (contd.)

Retirements by Years

Year	Feet	Year	Feet
Installed			
1927	20	1939	
1928	52	1929	
1930	38	1936	
1931	16	1939	
1933	12	1940	
1937	166	1939	

1½-IN. COPPER SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1938	24	24	0
1940	256	256	0
1941	64	64	0
1942	0	0	0
TOTAL	344	344	0

1½-IN. COPPER SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1935	131	131	0
1936	109	109	0
1937	58	58	0
1938	61	61	0
1939	134	134	0
1940	38	38	0
1941	62	62	0
1942	0	0	0
TOTAL	593	593	0

2-IN. COPPER SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1927	95	95	0
1928	249	249	0
1929	409	409	0
1930	297	297	0
1931	194	194	0
1932	147	147	0
1933	126	126	0
1934	166	166	0
1935	131	131	0
1936	72	72	0
1937	98	98	0
1938	76	76	0
1939	13	13	0
1940	108	108	0
1941	132	132	0
1942	0	0	0
TOTAL	2,313	2,313	0

3-IN. CAST-IRON SERVICES

Year	Feet		
Installed	Installed	In Service	Retired
1884	62	0	62
1895	16	0	16
1899	149	149	0
1900	205	98	107
1906	28	28	0
1942	0	0	0
TOTAL	460	275	185

Retirements by Years

Year	Feet	Year	Feet	Year	Feet	Year	Feet
Installed							
1884	16	1895	46	1902			
1895	16	1907					
1900	23	1912	52	1924	32	1939	

4-IN. CAST-IRON SERVICES

Year	Feet			Year	Feet		
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1887	78	78	0	1903	111	111	0
1888	66	66	0	1904	544	485	59
1890	15	15	0	1905	228	172	56
1893	50	50	0	1906	553	431	122
1895	30	0	30	1907	468	468	0
1899	46	46	0	1908	436	436	0
1900	275	275	0	1909	705	705	0
1901	319	319	0	1910	897	878	19
1902	288	274	14	1911	74	74	0

4-IN. CAST-IRON SERVICES (contd.)

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1912	1,461	1,376	85	1937	46	46	0
1913	558	558	0	1938	19	19	0
1914	501	501	0	1939	116	116	0
1915	380	380	0	1940	106	106	0
1916	235	235	0	1941	14	14	0
1917	165	165	0	1942	0	0	0
1918	117	117	0				
1919	283	283	0	SUBTOTAL	11,674	11,261	413
1920	261	247	14	Unknown	10	10	
1921	209	209	0				
1922	346	346	0	TOTAL	11,684	11,271	413
1923	14	14	0				
1924	252	252	0				
1925	42	28	14				
1926	212	212	0				
1927	219	219	0				
1928	91	91	0				
1929	210	210	0				
1930	256	256	0				
1931	150	150	0				
1932	126	126	0				
1933	23	23	0				
1934	15	15	0				
1935	64	64	0				

<i>Retirements by Years</i>							
<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1895	30	1903					
1902	14	1941					
1904	59	1937					
1905	56	1932					
1906	122	1933					
1910	19	1939					
1912	18	1934	53	1935	14	1941	
1920	14	1935					
1925	14	1927					

6-IN. CAST-IRON SERVICES

<i>Year</i>	<i>Feet</i>			<i>Year</i>	<i>Feet</i>		
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1898	46	46	0	1926	470	470	0
1899	20	20	0	1927	167	167	0
1904	267	267	0	1928	446	446	0
1905	19	19	0	1929	180	180	0
1906	347	347	0	1930	351	351	0
1907	226	226	0	1931	288	288	0
1908	83	83	0	1932	114	114	0
1909	227	227	0	1933	152	152	0
1910	22	22	0	1934	145	145	0
1911	188	188	0	1935	304	304	0
1912	458	458	0	1936	60	60	0
1913	159	159	0	1937	83	83	0
1914	166	166	0	1938	57	57	0
1915	170	170	0	1939	393	393	0
1916	71	71	0	1940	228	228	0
1917	14	14	0	1941	55	55	0
1918	14	14	0	1942	0	0	0
1919	68	68	0				
1920	109	109	0	TOTAL	7,243	7,188	55
1921	22	22	0				
1922	105	105	0				
1923	373	373	0				
1924	281	226	55				
1925	295	295	0				

<i>Retirements by Years</i>			
<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>
1924	55	1941	

SURVIVAL AND RETIREMENT

8-IN. CAST-IRON SERVICES

Year				Feet			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1913	25	25	0	1929	208	208	0
1914	9	9	0	1931	12	12	0
1915	100	100	0	1939	55	55	0
1916	48	48	0	1940	20	20	0
1925	24	24	0	1942	0	0	0
1926	224	224	0				
1928	14	14	0	TOTAL	739	739	0

½-IN. LEAD SERVICES

Year				Feet			
Installed	Installed	In Service	Retired	Installed	Installed	In Service	Retired
1894	3,750	1,426	2,324	1918	2,884	2,542	342
1895	3,793	1,322	2,471	1919	3,809	3,529	280
1896	2,490	1,184	1,306	1920	10,580	8,376	2,204
1897	2,145	823	1,322	1921	16,536	15,121	1,415
1898	1,683	668	1,015	1922	24,311	23,170	1,141
1899	5,994	1,629	4,365	1923	18,197	17,810	387
1900	9,536	3,142	6,394	1924	13,380	13,164	216
1901	7,671	2,419	5,252	1925	16,500	16,187	313
1902	1,494	1,203	291	1926	17,316	16,835	481
1903	29,393	23,713	5,680	1927	15,937	15,651	286
1904	29,297	23,975	5,322	1928	13,760	13,538	222
1905	52,802	40,861	11,941	1929	1,809	1,757	52
1906	55,825	43,984	11,841	1930	2,374	2,360	14
1907	40,588	35,303	5,285	1931	648	648	0
1908	19,823	17,337	2,486	1932	258	258	0
1909	29,899	27,016	2,883	1933	10	10	0
1910	36,883	31,741	5,142	1941	378	378	0
1911	42,394	37,329	5,065	1942	1,261	1,261	0
1912	47,150	43,576	3,574				
1913	38,440	34,064	4,376	SUBTOTAL	655,752	554,702	101,050
1914	23,929	20,038	3,891	Unknown	2,181	520	1,661
1915	5,296	4,912	384				
1916	2,568	1,988	580	TOTAL	657,933	555,222	102,711
1917	2,961	2,406	555				

Retirements by Years

Year							Year						
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1894	58	1896	61	1898	101	1899	1895	66	1900	76	1901	150	1902
	6	1900	17	1901	20	1903		53	1905	20	1907	31	1908
	36	1904	77	1905	80	1906		80	1910	20	1911	224	1912
	46	1907	149	1908	112	1909		46	1913	273	1914	46	1915
	59	1910	46	1911	47	1913		46	1916	20	1917	21	1918
	20	1915	16	1916	32	1917		92	1919	132	1920	96	1921
	95	1918	20	1920	132	1922		20	1922	170	1923	20	1924
	46	1923	86	1924	46	1925		46	1925	17	1926	80	1927
	40	1926	46	1927	149	1928		92	1929	67	1933	46	1934
	20	1929	46	1930	63	1932		46	1935	20	1936	46	1937
	227	1933	46	1936	65	1937		46	1938	186	1939	46	1940
	46	1938	105	1939				31	1941				

$\frac{1}{2}$ -IN. LEAD SERVICES (contd.)

Retirements by Years (contd.)

Year Installed Feet						Year Installed Feet					
Year	Feet	Year	Feet	Year	Feet	Year	Feet	Year	Feet	Year	Feet
1896	47	1904	80	1905	195	1906	176	1914	110	1915	320
	71	1907	7	1908	46	1910	370	1917	136	1918	156
	46	1918	20	1920	102	1921	193	1920	191	1921	98
	46	1923	66	1924	32	1925	159	1923	152	1924	202
	40	1927	98	1929	134	1930	80	1926	46	1927	10
	58	1931	20	1932	27	1933	124	1929	14	1930	66
	20	1934	77	1936	20	1939	56	1932	74	1933	56
	34	1940	20	1941			52	1936	98	1937	67
1897	69	1900	58	1903	48	1905	164	1939	44	1940	
	70	1906	47	1911	46	1912	1902	25	1907	66	1918
	127	1913	46	1914	20	1916	20	1921	104	1926	20
	85	1919	20	1925	66	1926	18	1935	14	1939	14
	395	1927	20	1929	20	1937	1903	56	1903	92	1906
	66	1938	119	1939			166	1910	196	1911	139
1898	136	1899	15	1901	60	1904	444	1913	98	1914	138
	111	1906	26	1912	37	1913	14	1918	144	1919	276
	66	1914	70	1919	66	1920	286	1921	162	1922	94
	46	1922	46	1924	86	1926	92	1924	146	1925	126
	20	1928	70	1930	37	1934	186	1927	110	1928	82
	20	1935	43	1936	20	1937	171	1930	90	1931	88
	20	1939	20	1942			136	1933	196	1934	258
1899	36	1900	36	1901	36	1902	341	1936	210	1937	258
	126	1903	52	1904	184	1905	266	1939	232	1940	160
	83	1906	164	1907	294	1908	213	1942			
	224	1909	215	1910	140	1911	1904	16	1905	32	1906
	246	1912	72	1913	113	1914	46	1908	61	1910	80
	217	1915	46	1916	67	1918	174	1912	488	1913	124
	166	1919	274	1920	50	1921	28	1915	48	1916	14
	66	1922	138	1923	98	1924	20	1918	63	1919	152
	46	1925	154	1926	106	1927	114	1921	80	1922	134
	36	1928	20	1929	212	1930	136	1925	98	1926	222
	52	1931	14	1933	14	1935	66	1928	146	1929	92
	26	1937	124	1938	188	1940	256	1931	131	1932	342
	63	1941	32	1942			136	1934	220	1935	106
1900	66	1900	76	1901	150	1902	414	1937	92	1938	454
	133	1905	220	1906	268	1907	201	1940	246	1941	244
	214	1908	298	1909	245	1910	1905	24	1905	60	1906
	24	1911	217	1912	338	1913	74	1908	73	1909	62
	151	1914	94	1915	64	1916	248	1911	205	1912	497
	306	1917	266	1918	216	1919	272	1914	313	1915	74
	214	1920	147	1921	209	1922	14	1917	48	1918	26
	232	1923	304	1924	86	1925	439	1920	345	1921	184
	230	1926	285	1927	159	1928	387	1923	86	1924	385
	24	1929	182	1930	52	1931	310	1926	258	1927	430
	54	1932	74	1933	69	1934	476	1929	390	1930	624
	160	1936	249	1937	80	1938	263	1932	340	1933	504
	98	1939	66	1940	60	1941	208	1935	438	1936	563
	14	1942					563	1937	564	1938	656
1901	20	1901	29	1903	10	1904	532	1940	979	1941	437
	65	1905	315	1906	172	1907	52	1906	106	1907	114
	358	1908	320	1909	140	1910	106	1909	399	1910	269
	164	1911	274	1912	171	1913	163	1912	264	1913	169

$\frac{1}{2}$ -IN. LEAD SERVICES (contd.)

Retirements by Years (contd.)

Year						Year					
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year
1906	221	1915	150	1916	41	1917	1910	152	1934	50	1935
	60	1918	114	1919	419	1920		662	1937	466	1938
	315	1921	206	1922	258	1923		354	1940	458	1941
	428	1924	407	1925	302	1926		74	1911	341	1912
	279	1927	387	1928	313	1929	1911	80	1914	12	1915
	352	1930	609	1931	354	1932		40	1917	46	1918
	283	1933	196	1934	309	1935		165	1920	157	1921
	623	1936	541	1937	677	1938		161	1923	128	1924
	762	1939	373	1940	880	1941	1912	40	1927	52	1928
	340	1942						114	1930	88	1931
	16	1907	46	1910	55	1911		264	1933	292	1934
1907	97	1912	196	1913	66	1914		264	1936	452	1937
	14	1915	24	1916	155	1917	1913	290	1939	354	1940
	46	1918	96	1919	217	1920		150	1942		
	206	1921	139	1922	94	1923		102	1913	40	1914
	88	1924	74	1925	40	1926		50	1916	40	1918
	163	1927	45	1928	246	1929	1914	163	1920	34	1921
	60	1930	121	1931	154	1932		168	1923	24	1924
	123	1933	274	1934	369	1935		160	1928	90	1929
	350	1936	323	1937	160	1938		10	1931	99	1932
	295	1939	312	1940	369	1941	1915	66	1934	367	1935
	252	1942						126	1937	311	1938
1908	12	1908	14	1909	40	1910		386	1940	312	1941
	16	1911	147	1912	52	1913		126	1913	14	1916
	60	1914	92	1918	46	1919	1916	66	1920	127	1922
	20	1920	25	1921	52	1922		140	1924	358	1925
	37	1923	55	1924	14	1925		126	1927	128	1928
	14	1927	100	1928	60	1929		134	1930	196	1931
	76	1930	76	1931	97	1932	1917	268	1933	144	1934
	127	1933	14	1934	52	1935		270	1936	241	1937
	144	1936	86	1937	140	1938		204	1939	462	1940
	266	1939	245	1940	203	1941		182	1942		
	104	1942					1918	40	1914	52	1915
1909	80	1911	34	1912	60	1913		43	1917	50	1918
	52	1914	153	1915	72	1916		136	1920	190	1921
	104	1917	79	1918	65	1919		75	1923	36	1924
	52	1920	66	1921	34	1922		132	1927	40	1928
	14	1923	14	1925	88	1926	1919	149	1930	42	1931
	50	1927	66	1928	132	1929		116	1933	330	1934
	184	1930	80	1931	54	1932		254	1936	426	1937
	64	1933	106	1934	52	1935		112	1939	158	1940
	64	1936	76	1937	118	1938	1920	132	1942		
	330	1939	100	1940	166	1941		29	1915	14	1926
	274	1942						78	1928	24	1929
1910	52	1911	260	1912	52	1913		14	1938	14	1939
	130	1914	47	1915	54	1917	1921	52	1941		
	12	1919	92	1920	50	1921		52	1918	46	1920
	132	1922	14	1923	83	1924		14	1924	46	1925
	161	1925	191	1926	94	1927		16	1932	77	1934
	156	1928	63	1929	114	1930	1922	14	1937	18	1938
	238	1931	66	1932	88	1933		14	1941	72	1942

$\frac{1}{2}$ -IN. LEAD SERVICES (contd.)

Retirements by Years (contd.)

Year Installed	Feet	Year	Feet	Year	Feet	Year	Year Installed	Feet	Year	Feet	Year	Feet	Year
1917	104	1920	60	1922	46	1923	1922	62	1923	26	1928	64	1929
	46	1926	52	1928	66	1929		107	1930	93	1931	104	1932
	7	1934	14	1936	56	1939		74	1934	175	1937	96	1938
	52	1940	52	1941				165	1939	116	1940	59	1941
1918	52	1921	52	1923	46	1924	1923	46	1926	46	1929	14	1930
	46	1926	14	1933	28	1936		12	1933	52	1934	34	1937
	28	1939	16	1940	60	1942		66	1939	52	1940	23	1941
1919	14	1920	10	1922	14	1929		42	1942				
	34	1930	50	1935	14	1936	1924	52	1934	52	1935	32	1937
	14	1938	66	1939	66	1941		14	1938	52	1939	14	1940
1920	21	1921	52	1922	37	1923	1925	20	1927	25	1929	48	1930
	52	1924	89	1925	104	1926		20	1931	52	1937	52	1938
	104	1928	72	1929	215	1930		82	1939	14	1940		
	36	1931	52	1932	170	1933	1926	72	1928	52	1929	14	1931
	46	1934	62	1935	126	1936		14	1936	60	1937	41	1939
	180	1937	429	1938	72	1939		80	1940	128	1941	20	1942
	104	1940	64	1941	117	1942	1927	28	1933	52	1935	156	1937
1921	66	1923	14	1924	46	1926		14	1939	36	1940		
	97	1928	126	1929	28	1930	1928	128	1932	52	1935	14	1937
	52	1931	52	1932	28	1933		14	1939	14	1941		
	52	1935	156	1936	156	1937	1929	52	1929				
	52	1938	222	1939	112	1940	1930	14	1942				
	156	1941											

 $\frac{3}{8}$ -IN. LEAD SERVICES

Year Installed	Feet			Year Installed	Feet		
	Installed	In Service	Retired		Installed	In Service	Retired
1895	160	160	0	1919	830	750	80
1898	77	31	46	1920	2,832	2,663	169
1899	1,253	678	575	1921	2,688	2,477	211
1900	4,191	2,574	1,617	1922	3,271	2,802	469
1901	6,207	4,129	2,078	1923	2,341	2,275	66
1902	17,730	11,683	6,047	1924	2,252	2,238	14
1903	7,723	5,470	2,253	1925	2,058	2,037	21
1904	14,203	12,362	1,841	1926	2,344	2,258	86
1905	29,551	25,685	3,866	1927	3,004	3,004	0
1906	26,121	21,117	5,004	1928	1,003	933	70
1907	15,676	12,642	3,034	1929	942	942	0
1908	15,847	14,461	1,386	1930	204	204	0
1909	12,745	10,531	2,214	1931	255	255	0
1910	14,966	12,855	2,111	1939	112	112	0
1911	18,301	17,301	1,000	1941	438	438	0
1912	20,035	18,327	1,708	1942	656	604	52
1913	17,351	14,980	2,371				
1914	10,003	9,065	938	SUBTOTAL	259,905	220,460	39,445
1915	1,056	1,004	52	Unknown	698	96	602
1916	464	412	52				
1917	513	499	14	TOTAL	260,603	220,556	40,047
1918	502	502	0				

I-IN. LEAD SERVICES (contd.)

Retirements by Years

<i>Year Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Year Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1898	46	1940					1904	184	1936	52	1937	88	1938
1899	60	1905	33	1913	68	1914		170	1939	66	1940	150	1941
	14	1917	46	1920	20	1921		14	1942				
	14	1922	20	1923	52	1929	1905	14	1905	14	1907	12	1909
	46	1932	20	1933	68	1935		50	1912	316	1913	70	1914
	18	1939	82	1940	14	1942		52	1915	18	1918	8	1919
1900	75	1900	40	1905	29	1906		118	1920	173	1921	97	1922
	20	1907	78	1910	52	1913		86	1924	183	1925	89	1928
	46	1914	14	1918	46	1919		84	1929	144	1930	186	1931
	154	1920	66	1921	14	1924		94	1932	88	1933	208	1934
	12	1926	52	1927	95	1928		217	1935	242	1936	278	1937
	150	1929	100	1930	119	1931		214	1938	246	1939	48	1940
	46	1935	68	1936	102	1937		375	1941	147	1942		
	66	1938	41	1939	46	1940	1906	74	1909	48	1910	77	1911
	86	1941						182	1912	52	1913	29	1914
1901	52	1901	66	1903	20	1905		68	1916	100	1917	52	1918
	66	1906	98	1907	39	1908		80	1919	122	1920	118	1921
	34	1910	154	1911	208	1913		125	1922	104	1923	54	1924
	25	1914	65	1915	30	1916		104	1925	167	1926	129	1927
	40	1917	138	1919	64	1921		173	1928	117	1929	301	1930
	143	1922	59	1924	52	1926		246	1931	156	1932	313	1933
	10	1927	65	1928	25	1930		222	1934	156	1935	244	1936
	69	1931	46	1932	40	1933		138	1937	176	1938	501	1939
	72	1936	52	1938	86	1939		158	1940	366	1941	52	1942
	46	1940	52	1941	162	1942	1907	14	1910	109	1911	66	1912
1902	59	1903	82	1906	203	1907		28	1913	14	1914	14	1915
	128	1908	14	1910	136	1911		106	1918	20	1919	121	1920
	20	1912	351	1913	184	1914		52	1921	114	1922	66	1923
	42	1915	106	1916	12	1917		237	1924	142	1925	92	1927
	108	1918	120	1919	164	1920		14	1928	167	1929	52	1930
	155	1921	127	1922	208	1923		220	1931	92	1932	108	1934
	14	1924	206	1925	112	1926		104	1935	105	1936	88	1937
	188	1927	286	1928	256	1929		138	1938	160	1939	352	1940
	48	1930	148	1931	310	1932		198	1941	41	1942		
	83	1933	268	1934	104	1935	1908	24	1912	52	1916	12	1918
	294	1936	124	1937	462	1938		52	1919	38	1920	14	1921
	350	1939	261	1940	104	1941		130	1922	46	1923	52	1924
	210	1942						89	1929	10	1930	14	1931
1903	60	1906	84	1908	62	1910		46	1932	97	1933	52	1934
	14	1913	14	1917	56	1919		156	1936	96	1937	52	1938
	156	1920	52	1921	14	1923		68	1940	178	1941	108	1942
	123	1924	52	1925	152	1926	1909	52	1912	24	1913	52	1914
	108	1927	170	1928	216	1929		14	1915	81	1918	14	1919
	122	1931	52	1932	196	1933		72	1920	118	1922	150	1923
	60	1934	60	1935	20	1937		62	1924	106	1926	143	1929
	30	1938	180	1939	80	1940		66	1931	14	1932	138	1933
	120	1942						52	1934	66	1935	150	1936
1904	46	1907	79	1909	52	1911		232	1937	152	1938	52	1939
	14	1912	66	1913	72	1915		158	1940	80	1941	166	1942
	52	1919	24	1920	80	1921	1910	130	1912	10	1913	52	1917
	156	1924	36	1925	95	1927		95	1919	8	1920	14	1922
	58	1928	14	1929	66	1931		66	1924	50	1926	20	1927
	52	1932	103	1934	52	1935		118	1930	98	1931	40	1933

$\frac{3}{4}$ -IN. LEAD SERVICES (contd.)*Retirements by Years (contd.)*

<i>Year</i>						<i>Year</i>					
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1910	86	1934	96	1935	60	1936	1913	343	1941	52	1942
	178	1937	66	1938	112	1939	1914	24	1917	52	1921
	208	1940	500	1941	104	1942		52	1929	52	1930
1911	10	1912	52	1915	66	1920		46	1933	52	1934
	42	1922	92	1923	38	1925		152	1936	152	1937
	24	1929	14	1930	14	1932		52	1940	12	1941
	40	1936	52	1937	14	1939	1915	52	1942		
	168	1940	374	1941			1916	52	1919		
1912	14	1914	52	1916	60	1917	1917	14	1921		
	12	1919	229	1920	52	1922	1919	52	1921	10	1935
	44	1923	40	1924	30	1925	1920	14	1922	14	1929
	52	1926	11	1927	24	1928		54	1934	52	1937
	102	1929	14	1930	118	1932	1921	14	1926	47	1933
	126	1933	106	1934	60	1935		46	1940	52	1941
	102	1936	102	1937	170	1938	1922	20	1923	136	1929
	66	1939	42	1940	14	1941		32	1934	18	1935
	66	1942						138	1938	58	1939
1913	52	1920	156	1923	70	1924	1923	14	1930	52	1931
	104	1925	52	1926	46	1928	1924	14	1934		
	52	1929	118	1930	90	1931	1925	21	1937		
	46	1932	96	1933	66	1934	1926	52	1930	20	1938
	106	1935	104	1936	196	1937	1928	56	1931	14	1941
	196	1938	172	1939	254	1940	1942	52	1942		

 $\frac{3}{4}$ -IN. LEAD SERVICES

<i>Year</i>				<i>Year</i>			
<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>	<i>Installed</i>	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1894	1,560	806	754	1917	484	377	107
1895	2,741	1,103	1,638	1918	1,044	942	102
1896	1,818	1,177	641	1919	760	657	103
1897	1,663	865	798	1920	1,654	1,408	246
1898	1,453	753	700	1921	1,512	1,345	167
1899	2,628	2,035	593	1922	2,203	2,151	52
1900	1,675	850	825	1923	1,506	1,322	184
1901	2,065	1,102	963	1924	1,427	1,151	276
1902	4,049	2,992	1,057	1925	1,654	1,541	113
1903	5,357	4,065	1,292	1926	1,541	1,423	118
1904	5,462	4,589	873	1927	1,304	1,264	40
1905	5,137	3,689	1,448	1928	1,293	1,279	14
1906	10,827	9,170	1,657	1929	1,952	1,938	14
1907	3,670	2,691	979	1930	672	672	0
1908	3,162	2,564	598	1931	342	316	26
1909	4,136	3,042	1,094	1932	76	76	0
1910	3,745	3,010	735	1939	66	66	0
1911	3,690	3,166	524	1942	9,452	9,452	0
1912	5,210	3,779	1,431				
1913	4,041	3,433	608	SUBTOTAL	107,737	86,571	21,166
1914	3,164	2,824	340	Unknown	1,560	332	1,228
1915	1,039	1,001	38				
1916	503	485	18	TOTAL	109,297	86,903	22,394

$\frac{1}{2}$ -IN. LEAD SERVICES (contd.)

Retirements by Years

Year							Year						
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1894	20	1899	20	1906	46	1907	1903	29	1921	74	1922	56	1924
	15	1908	15	1914	130	1921		42	1925	18	1926	32	1927
	66	1922	120	1924	20	1926		14	1928	42	1929	142	1930
	46	1928	106	1929	46	1936		14	1931	14	1934	78	1936
	104	1939						120	1937	46	1939	126	1940
1895	62	1898	20	1900	114	1906	1904	46	1941				
	39	1910	48	1912	20	1916		46	1905	26	1907	25	1908
	66	1920	149	1922	19	1924		46	1910	52	1913	76	1914
	52	1925	46	1928	228	1929		20	1920	20	1921	52	1922
	46	1930	225	1932	46	1933		46	1926	14	1929	76	1931
	20	1934	46	1935	282	1937		14	1932	40	1934	104	1935
	64	1939	46	1940				46	1937	36	1938	48	1939
1896	46	1907	117	1908	46	1917	1905	52	1940	14	1941	20	1942
	32	1920	144	1921	46	1930		40	1908	44	1910	66	1911
	14	1936	112	1939	17	1940		27	1912	52	1913	24	1915
	46	1941	21	1942				98	1917	12	1918	66	1920
	46	1902	7	1908	105	1913		20	1921	104	1922	52	1926
1897	135	1919	16	1921	20	1922		36	1928	100	1929	88	1930
	46	1923	34	1926	97	1930		14	1931	42	1932	54	1933
	20	1932	20	1933	100	1936		38	1934	14	1935	151	1936
	86	1939	46	1940	20	1941		70	1938	110	1939	106	1940
	50	1902	67	1905	14	1906	1906	20	1941				
1898	197	1908	40	1910	20	1911		46	1906	27	1910	27	1911
	42	1913	18	1914	138	1920		49	1912	56	1914	41	1917
	20	1921	22	1930	46	1931		82	1919	46	1920	45	1921
	26	1936						23	1925	80	1926	30	1927
	14	1904	26	1914	12	1915		83	1928	46	1929	67	1930
1899	46	1922	52	1923	52	1925		54	1931	27	1932	173	1933
	52	1926	56	1929	52	1930		66	1934	25	1935	56	1936
	69	1931	52	1936	20	1937		166	1939	96	1940	32	1941
	60	1941	30	1942				214	1942				
	46	1901	24	1903	20	1904	1907	140	1913	46	1916	52	1918
1900	154	1908	20	1910	73	1915		12	1920	31	1921	56	1922
	20	1919	14	1921	10	1924		45	1925	52	1932	52	1933
	42	1926	20	1927	66	1930		52	1934	46	1935	52	1936
	12	1933	46	1935	7	1936		56	1937	175	1939	52	1940
	99	1939	152	1940			1908	60	1941				
1901	32	1903	97	1908	70	1910		20	1909	108	1911	14	1912
	33	1912	120	1913	29	1915		62	1913	58	1915	37	1916
	30	1916	20	1917	15	1918		25	1929	104	1935	14	1938
	114	1919	55	1920	15	1921		104	1939	52	1940		
	62	1924	56	1926	97	1939	1909	42	1911	52	1912	124	1913
1902	14	1940	104	1941				54	1914	82	1919	52	1921
	112	1903	48	1905	14	1908		62	1929	14	1930	52	1931
	46	1911	116	1913	14	1914		52	1936	66	1937	168	1938
	24	1915	50	1922	46	1923		50	1939	196	1940	28	1941
	24	1927	84	1928	59	1929	1910	37	1912	64	1913	60	1926
1903	14	1930	24	1932	66	1933		110	1928	28	1929	14	1932
	20	1934	78	1935	52	1936		98	1934	96	1936	88	1938
	30	1937	47	1938	31	1939		20	1939	14	1940	156	1941
	14	1941	44	1942				52	1916	16	1917	20	1921
	28	1905	53	1908	52	1911	1911	52	1924	36	1930	52	1935
	72	1912	128	1913	66	1914		52	1936	52	1937	126	1938

$\frac{3}{4}$ -IN. LEAD SERVICES (contd.)*Retirements by Years (contd.)*

<i>Year</i>							<i>Year</i>						
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1911	52	1939	14	1940			1917	20	1918	46	1935	41	1937
1912	46	1914	27	1916	52	1918	1918	50	1929	52	1941		
	52	1919	90	1922	14	1924	1919	20	1921	83	1941		
	46	1925	14	1927	46	1928	1920	52	1922	14	1926	62	1929
	137	1929	46	1931	66	1932		66	1940	52	1941		
	14	1934	52	1936	104	1937	1921	129	1936	38	1939		
	193	1938	54	1939	222	1940	1922	52	1942				
	104	1941	52	1942			1923	14	1926	52	1935	118	1941
1913	42	1924	14	1928	52	1931	1924	82	1930	90	1939	104	1941
	88	1933	52	1934	156	1936	1925	52	1937	9	1939	52	1941
	86	1937	52	1939	52	1940	1926	52	1936	14	1940	52	1941
	14	1942					1927	26	1931	14	1939		
1914	26	1915	46	1927	14	1928	1928	14	1940				
	104	1936	52	1938	98	1940	1929	14	1941				
1915	14	1926	24	1931			1931	26	1937				
1916	18	1938											

1-IN. LEAD SERVICES

<i>Year</i>				<i>Year</i>			
<i>Installed</i>	<i>Feet</i>			<i>Installed</i>	<i>Feet</i>		
	<i>Installed</i>	<i>In Service</i>	<i>Retired</i>		<i>Installed</i>	<i>In Service</i>	<i>Retired</i>
1897	90	20	70	1919	1,292	1,137	155
1898	20	0	20	1920	1,199	990	209
1899	130	78	52	1921	885	743	142
1900	455	455	0	1922	928	669	259
1901	387	236	151	1923	630	520	110
1902	462	388	74	1924	1,075	818	257
1903	212	152	60	1925	848	727	121
1904	791	573	218	1926	1,655	1,655	0
1905	2,218	2,037	181	1927	1,136	1,070	66
1906	2,648	2,200	448	1928	1,192	1,192	0
1907	1,534	1,292	242	1929	1,111	1,111	0
1908	1,378	952	426	1930	334	334	0
1909	2,491	2,402	89	1932	14	14	0
1910	3,191	2,872	319	1933	26	26	0
1911	4,117	3,728	389	1939	15	15	0
1912	5,659	5,144	515	1942	0	0	0
1913	4,169	3,824	345				
1914	5,134	4,832	302	SUBTOTAL	51,054	45,300	5,754
1915	860	860	0	Unknown	357	46	311
1916	801	693	108				
1917	975	755	220	TOTAL	51,411	45,346	6,065
1918	992	786	206				

Retirements by Years

<i>Year</i>							<i>Year</i>						
<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Installed</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>	<i>Feet</i>	<i>Year</i>
1897	70	1915					1902	20	1906	54	1933		
1898	20	1935					1903	46	1909	14	1926		
1899	52	1928					1904	98	1909	14	1927	46	1932
1901	46	1903	105	1908				14	1935	46	1940		

SURVIVAL AND RETIREMENT

1-IN. LEAD SERVICES (contd.)

Retirements by Years (contd.)

Year							Year						
Installed	Feet	Year	Feet	Year	Feet	Year	Installed	Feet	Year	Feet	Year	Feet	Year
1905	40	1907	15	1922	14	1928	1913	20	1914	21	1922	14	1924
	20	1929	46	1936	12	1937		40	1931	44	1936	46	1939
	34	1939						28	1940	132	1941		
1906	15	1912	28	1913	15	1925	1914	12	1917	14	1927	52	1931
	16	1927	66	1929	78	1932		14	1934	14	1937	14	1938
	40	1933	104	1934	20	1935		40	1939	10	1940	132	1941
	20	1936	46	1938			1916	108	1940				
1907	58	1913	14	1927	31	1928	1917	36	1920	132	1926	52	1940
	20	1930	39	1937	80	1940	1918	59	1929	104	1935	43	1939
1908	30	1913	54	1920	46	1923	1919	28	1922	63	1936	46	1940
	24	1925	81	1928	44	1929		18	1941				
	114	1930	33	1939			1920	144	1930	14	1934	28	1936
1909	24	1926	13	1927	52	1934		23	1939				
1910	52	1910	48	1913	14	1919	1921	14	1928	52	1931	76	1936
	10	1921	15	1924	58	1929	1922	186	1933	38	1935	21	1936
	60	1937	58	1940	14	1941		14	1942				
1911	14	1917	10	1928	75	1934	1923	24	1928	86	1941		
	16	1939	118	1940	156	1941	1924	108	1937	129	1939	20	1941
1912	33	1914	43	1920	40	1924	1925	54	1927	15	1935	52	1941
	21	1926	46	1933	16	1935	1927	14	1927	52	1941		
	52	1938	62	1940	202	1941							

1½-IN. LEAD SERVICES

Year				Retirements by Years		
Installed	Feet			Year	Feet	Year
	Installed	In Service	Retired	Installed		
1899	18	0	18	1899	18	1939
1910	104	104	0			
1942	0	0	0			
TOTAL	122	104	18			

2-IN. LEAD SERVICES

Year				Retirements by Years		
Installed	Feet			Year	Feet	Year
	Installed	In Service	Retired	Installed		
1895	21	0	21	1895	21	1919
1906	116	70	46	1906	46	1928
1917	48	48	0	1918	10	1935
1918	24	14	10			
1919	160	160	0			
1931	52	52	0			
1942	0	0	0			
TOTAL	421	344	77			

SUMMARY TABLES

Summary Tables

TO draw together the information collected in the twenty-six foregoing studies, the Committee presents below a series of tables in which the data on Class A facilities have been summarized by cities and by sizes and classes. These data are being offered here as a factual basis upon which further investigation and study may be predicated. Their interpretation has been considered without the scope of the Committee.

SUMMARY OF MAINS—BY CITIES

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Alexandria, Va.	1852	454,223	20,560	4.5	433,663	27.0
Babylon, N.Y.	1893	246,718	548	0.2	246,170	22.0
Clinton, Iowa	1875	184,657	24,845	13.5	159,812	15.2
Clyde, N.Y.	1889	44,600	200	0.5	44,400	39.8
Denver, Colo.	1872	6,183,984	1,458,683	23.6	4,725,301	30.2
Des Moines, Iowa	1881	2,080,892	11,409	0.6	2,069,483	23.9
Detroit, Mich.	1840	16,300,343	1,332,933	8.2	14,967,410	24.6
Huntington, W.Va.	1887	1,050,635	93,549	8.9	957,086	23.8
Jamaica, N.Y.	1887	3,453,381	97,167	2.8	3,356,214	18.6
Merrick, N.Y.	1912	330,433	165	0.1	330,268	12.5
Norwich, N.Y.	1881	139,613	2,734	2.0	136,879	43.6
Ottawa, Ont.	1874	1,139,861	58,483	5.1	1,081,378	37.3
Philadelphia, Pa.	1817	13,358,419	1,194,598	8.9	12,163,821	42.3
Portland, Me.	1869	1,933,039	279,805	14.5	1,653,234	27.0
Rochester (Suburban), N.Y.	1905	652,644	6,772	1.0	645,872	24.9
Sag Harbor, N.Y.	1889	44,968	1,204	2.7	43,764	40.6
St. Marys, Pa.	1889	185,265	10,445	5.6	174,820	31.7
St. Paul, Minn.	1882	3,397,031	95,526	2.8	3,301,505	33.0
San Francisco, Calif.*	1862	1,368,488	260,023	19.0	1,108,465	23.1
Scranton, Pa.	1870	1,187,493	50,466	4.3	1,137,027	36.2
Springfield, Mass.	1864	2,321,642	476,489	20.5	1,845,153	29.6
Summit, N.J.	1889	1,761,902	45,043	2.6	1,716,859	21.9
Syracuse (Suburban), N.Y.	1910	456,882	12,349	2.7	444,533	18.8
Utica, N.Y.	1849	1,175,769	79,942	6.8	1,095,827	53.1
West Palm Beach, Fla.	1894	658,112	95,003	14.4	563,109	16.0
Winnipeg, Man.	1882	1,785,752	120,587	6.8	1,665,165	32.3
TOTAL, ft.		61,896,746	5,829,528	9.4	56,067,218	30.2
TOTAL, mi.		11,723	1,104		10,619	

* Steel and wrought-iron pipe only.

SUMMARY OF MAINS—By SIZES AND KINDS

Size, in.	Kind	No of Feet Installed	Retired		In Service	
			No of Feet	Percent- age of Total Installed	No of Feet	Average Age, yr
2	Cast-iron unlined	8,954	0	0	8,954	15.7
3		685,056	319,148	46.6	365,908	17.3
4		3,784,601	1,873,369	49.5	1,911,232	43.8
4½		430	430	100.0	0	—
5		352,067	36,836	10.5	315,231	53.8
6		24,622,862	1,156,436	4.7	23,466,426	35.2
8		12,872,279	287,464	2.2	12,584,815	22.0
10		1,615,801	69,688	4.3	1,546,113	44.5
12		4,816,717	164,230	3.4	4,652,487	27.5
14		142,030	1,905	1.3	140,125	29.0
15		36,653	144	0.4	36,509	55.3
16		1,710,875	63,447	3.7	1,647,428	30.6
18		131,953	2,683	2.0	129,270	36.2
20		864,906	64,555	7.5	800,351	37.2
22		2,660	2,660	100.0	0	—
24		1,183,356	27,287	2.3	1,156,069	24.7
30		732,090	55,085	7.5	677,005	40.3
36		495,835	7,477	1.5	488,358	27.2
39.37		2,286	0	0	2,286	16.5
41.34		2,483	0	0	2,483	16.5
42		275,816	2,519	0.9	273,297	33.7
48		478,927	22,261	4.6	456,666	34.9
60		4,897	0	0	4,897	18.6
72		13,514	0	0	13,514	10.5
93		13,150	0	0	13,150	10.5
SUBTOTAL		54,850,198	4,157,624	7.6	50,692,574	31.4
2	Cast-iron cement-lined	118,738	3,831	3.2	114,907	3.9
4		3,752	134	3.6	3,618	6.4
6		1,048,763	911	0.1	1,047,852	9.1
8		512,223	8,489	1.7	503,734	10.3
10		15,556	0	0	15,556	14.9
12		223,054	135	0.1	222,919	10.4
16		98,752	21	0.0	98,731	9.9
20		36,284	0	0	36,284	12.5
24		35,405	0	0	35,405	12.1
30		6,000	0	0	6,000	13.7
SUBTOTAL		2,098,527	13,521	0.6	2,085,006	9.4
8	Cast-iron bituminous-lined	15,229	0	0	15,229	1.5
12		8,641	0	0	8,641	1.5
16		4,330	0	0	4,330	1.5
SUBTOTAL		28,200	0	0	28,200	1.5

SUMMARY OF MAINS—BY SIZES AND KINDS (contd.)

Size, in	Kind	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percent- age of Total Installed	No. of Feet	Average Age, yr.
$\frac{3}{4}$	Wrought-iron	3,079	1,904	61.8	1,175	32.1
1		22,577	13,019	57.7	9,558	33.4
$1\frac{1}{4}$		16,413	9,949	60.6	6,464	32.4
$1\frac{1}{2}$		41,908	27,164	64.8	14,744	31.4
2		748,777	336,239	44.9	412,538	24.1
$2\frac{1}{2}$		4,752	3,752	79.0	1,000	32.8
3		4,747	1,313	27.7	3,434	16.2
4		6,309	4,619	73.2	1,690	43.5
5		876	0	0	876	41.5
6		27,921	1,654	5.9	26,267	40.0
8		2,116	1,510	71.4	606	14.1
10		230	125	54.3	105	30.5
12		6,692	0	0	6,692	29.6
13		850	394	46.4	456	50.5
16		980	980	100.0	0	—
18		4,475	4,475	100.0	0	—
22		63,652	32,529	51.1	31,123	53.5
23		6,215	72	1.2	6,143	49.5
30		247,968	122,735	49.5	125,233	41.1
33		2,409	0	0	2,409	55.5
36		154,587	68,267	44.2	86,320	47.6
37		14,300	2,425	17.0	11,875	51.4
42		1,072	0	0	1,072	10.5
43		133,824	11,546	8.6	122,278	52.1
54		34,811	0	0	34,811	24.7
66		14,548	0	0	14,548	12.5
SUBTOTAL		1,566,088	644,671	41.2	921,417	34.6
$\frac{1}{2}$	Steel	470	0	0	470	20.5
$\frac{3}{4}$		8,686	2,650	30.5	6,036	7.6
1		43,968	19,500	44.4	24,468	17.4
$1\frac{1}{4}$		65,741	31,295	47.6	34,446	15.7
$1\frac{1}{2}$		41,526	17,152	41.3	24,374	14.5
2		445,959	101,271	22.7	344,688	18.3
$2\frac{1}{2}$		1,929	448	23.2	1,481	15.2
3		5,049	2,251	44.6	2,798	14.2
4		6,313	2,676	42.4	3,637	17.6
6		896	0	0	896	2.5
8		1,325	104	7.8	1,221	42.4
10		9,733	0	0	9,733	2.7
12		32,051	9,834	30.7	22,217	19.2
16		67,365	19,572	29.1	47,793	16.8
18		13,144	0	0	13,144	2.5
20		75,259	0	0	75,259	8.6
21		128	0	0	128	6.5
22		13,740	0	0	13,740	38.3
$23\frac{1}{2}$		9,516	429	4.5	9,087	17.4
24		42,300	7,542	17.8	34,758	10.7
28		7,480	0	0	7,480	4.5

SURVIVAL AND RETIREMENT

SUMMARY OF MAINS—BY SIZES AND KINDS (contd.)

Size, in.	Kind	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percent- age of Total Installed	No. of Feet	Average Age, yr.
30	Steel (contd.)	38,829	2,936	7.6	35,893	10.5
34		4,162	0	0	4,162	23.1
36		84,033	0	0	84,033	6.9
40		6,006	0	0	6,006	50.5
42		133,455	3,067	2.3	130,388	19.7
44		77,485	0	0	77,485	11.1
48		159,648	3,535	2.2	156,113	18.4
50		2,633	0	0	2,633	15.5
51		25,247	0	0	25,247	16.9
54		99,558	0	0	99,558	11.8
57		12,581	0	0	12,581	2.5
60		231,971	0	0	231,971	10.9
63		17,563	0	0	17,563	2.5
66		91,602	0	0	91,602	6.4
72		34,480	0	0	34,480	11.5
76		3,858	0	0	3,858	5.5
78	649	0	0	649	3.5	
93	5,651	0	0	5,651	10.5	
SUBTOTAL		1,921,989	224,262	11.7	1,697,727	14.1
24	Concrete	3,899	0	0	3,899	4.5
30		47,107	0	0	47,107	1.8
36		4,092	0	0	4,092	27.4
38*		12,336	7,722	62.6	4,614	47.5
42		37,315	0	0	37,315	4.9
46		6,968	0	0	6,968	0.5
48		55,635	0	0	55,635	3.8
54		69,915	662	0.9	69,253	13.4
57		6,822	0	0	6,822	7.5
60		57,722	0	0	57,722	10.5
62		26,014	0	0	26,014	5.5
66		31,471	0	0	31,471	15.5
69		3,087	0	0	3,087	6.5
72*		66	0	0	66	29.5
84		619	0	0	619	15.5
SUBTOTAL		363,068	8,384	2.3	354,684	8.6
24	Wood	6,552	6,552	100.0	0	—
30		163,978	137,030	83.6	26,948	29.2
34		96,076	51,534	53.6	44,542	43.3
36		11,250	7,306	64.9	3,944	29.8
40		114,256	110,819	97.0	3,437	9.5
44		8,517	7,346	86.3	1,171	47.5
48		152,207	99,676	65.5	52,531	28.6
60		13,083	714	5.5	12,369	28.5
66		65,024	12,597	19.4	52,427	12.8
SUBTOTAL		630,943	433,574	68.7	197,369	27.6

* Tunnel.

SUMMARY OF MAINS—BY SIZES AND KINDS (contd.)

Size, in.	Kind	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percent- age of Total Installed	No of Feet	Average Age, yr.
2	Cement and wrought iron	1,610	1,610	100.0	0	—
3		51,765	51,765	100.0	0	—
4		20,352	20,352	100.0	0	—
6		53,737	53,737	100.0	0	—
8		31,459	31,459	100.0	0	—
10		2,485	2,485	100.0	0	—
12		17,081	17,081	100.0	0	—
16		22,206	22,206	100.0	0	—
18		3,580	3,580	100.0	0	—
20		80,968	55,739	68.8	25,229	71.5
24		115,445	76,606	66.4	38,839	65.0
26		18,072	10,872	60.2	7,200	61.5
SUBTOTAL		418,760	347,492	83.0	71,268	66.9
6	Asbestos-cement	571	0	0	571	2.5
8		4,732	0	0	4,732	1.7
10		10,086	0	0	10,086	4.3
14		431	0	0	431	10.5
18		859	0	0	859	9.6
SUBTOTAL		16,679	0	0	16,679	3.9
$\frac{5}{8}$	Lead	28	0	0	28	27.5
$\frac{3}{4}$		148	0	0	148	41.8
1		496	0	0	496	17.9
$1\frac{1}{2}$		18	0	0	18	14.5
$\frac{3}{4}$	Copper	91	0	0	91	3.5
1		480	0	0	480	3.8
$1\frac{1}{4}$		291	0	0	291	1.5
$1\frac{1}{2}$	Copper and brass	160	0	0	160	5.5
2		582	0	0	582	2.5
SUBTOTAL		2,294	0	0	2,294	9.2
GRAND TOTAL		61,896,746	5,829,528	9.4	56,067,218	30.2

SUMMARY OF MAINS
2-in. Cast-Iron Unlined Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Scranton, Pa.	1909	115	0	0	115	31.5
Summit, N.J.	1927	160	0	0	160	13.5
West Palm Beach, Fla.	1925	8,679	0	0	8,679	15.5
TOTAL		8,954	0	0	8,954	15.7

3-in. Cast-Iron Unlined Pipe

Denver, Colo.*	1881	389,159	79,363	20.4	309,796	11.0
Ottawa, Ont.	1874	46,075	18,628	40.4	27,447	50.7
Philadelphia, Pa.	1822	212,030	197,725	93.3	14,305	79.8
Scranton, Pa.	1896	7,679	800	10.4	6,879	20.9
Summit, N.J.	1927	2,362	0	0	2,362	13.5
Utica, N.Y.	1849	27,552	22,632	82.1	4,920	66.9
Winnipeg, Man.	1942	199	0	0	199	0.5
TOTAL		685,056	319,148	46.6	365,908	17.3

4-in. Cast-Iron Unlined Pipe

Alexandria, Va.	1852	97,978	1,425	1.5	96,553	48.2
Babylon, N.Y.	1893	51,808	9	0.0	51,799	27.6
Clinton, Iowa	1930	48	0	0	48	9.5
Clyde, N.Y.	1889	22,951	0	0	22,951	33.6
Denver, Colo.	1878	619,711	248,064	40.0	371,647	49.7
Des Moines, Iowa	1881	501	372	74.3	129	23.2
Detroit, Mich.	1854	1,075,394	856,624	79.7	218,770	46.9
Huntington, W Va.	1887	12,643	0	0	12,643	52.4
Jamaica, N.Y.	1887	111,985	28,853	25.8	83,132	42.7
Merrick, N.Y.	1912	45,250	36	0.1	45,214	20.6
Norwich, N.Y.	1881	46,498	793	1.7	45,705	45.3
Ottawa, Ont.	1884	42,449	3,392	8.0	39,057	38.4
Philadelphia, Pa.	1823	637,022	491,147	77.1	145,875	50.4
Portland, Me.	1869	39,128	14,325	36.6	24,803	51.7
Rochester (Suburban), N.Y.	1905	7,632	983	12.9	6,649	31.8
Sag Harbor, N.Y.	1889	26,231	1,100	4.2	25,131	40.4
St. Marys, Pa.	1891	64,543	571	0.9	63,972	36.0
St. Paul, Minn.	1882	87,409	16,630	19.0	70,779	46.7
Scranton, Pa.	1885	195,704	19,571	10.0	176,133	40.6
Springfield, Mass.	1870	81,909	39,710	48.5	42,199	36.8
Summit, N.J.	1889	163,047	5,501	3.4	157,546	41.4
Syracuse (Suburban), N.Y.	1910	1,860	0	0	1,860	17.8
Utica, N.Y.	1849	63,045	32,625	51.7	30,420	62.9
West Palm Beach, Fla.	1901	94,719	52,683	55.6	42,036	26.3
Winnipeg, Man.	1882	195,136	58,955	30.2	136,181	40.9
TOTAL		3,784,601	1,873,369	49.5	1,911,232	43.8

* Small amount of galvanized iron.

4½-in. Cast-Iron Unlined Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Philadelphia, Pa.	1817	430	430	100.0	0	—
TOTAL		430	430	100.0	0	—

5-in. Cast-Iron Unlined Pipe

Ottawa, Ont.	1874	337,292	27,831	8.3	309,461	53.8
Winnipeg, Man.	1883	14,775	9,005	60.9	5,770	54.4
TOTAL		352,067	36,836	10.5	315,231	53.8

6-in. Cast-Iron Unlined Pipe

Alexandria, Va.	1852	125,650	1,658	1.3	123,993	28.8
Babylon, N.Y.	1893	137,307	449	0.3	136,858	22.5
Clinton, Iowa	1876	54,549	12	0.0	54,537	17.0
Clyde, N.Y.	1889	11,533	0	0	11,533	51.5
Denver, Colo.	1878	1,915,355	276,424	14.4	1,638,931	36.4
Des Moines, Iowa	1881	261,499	1,956	0.7	259,543	29.5
Detroit, Mich.	1854	6,462,692	251,649	3.9	6,211,043	27.3
Huntington, W.Va.	1887	168,809	119	0.1	168,690	34.3
Jamaica, N.Y.	1887	1,397,003	45,831	3.3	1,351,172	22.9
Merrick, N.Y.	1912	87,389	73	0.1	87,316	15.2
Norwich, N.Y.	1881	46,122	224	0.5	45,898	42.7
Ottawa, Ont.	1875	360,631	4,328	1.2	356,303	25.3
Philadelphia, Pa.	1821	7,242,534	312,352	4.3	6,930,182	47.9
Portland, Me.	1869	623,014	106,250	17.1	516,764	31.8
Rochester (Suburban), N.Y.	1905	179,997	2,321	1.3	177,676	29.1
Sag Harbor, N.Y.	1889	9,919	0	0	9,919	47.1
St. Marys, Pa.	1891	26,781	0	0	26,781	35.9
St. Paul, Minn.	1882	2,243,024	44,136	2.0	2,198,888	32.6
Scranton, Pa.	1886	448,494	14,159	3.2	434,335	31.0
Springfield, Mass.	1866	527,998	45,728	8.7	482,270	41.9
Summit, N.J.	1889	634,908	1,283	0.2	633,625	26.1
Syracuse (Suburban), N.Y.	1910	35,838	50	0.1	35,788	18.4
Utica, N.Y.	1849	596,806	10,972	1.8	585,834	37.7
West Palm Beach, Fla.	1894	73,038	9,987	13.7	63,051	24.2
Winnipeg, Man.	1882	951,972	26,475	2.8	925,497	32.7
TOTAL		24,622,862	1,156,436	4.7	23,466,426	35.2

8-in. Cast-Iron Unlined Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Alexandria, Va.	1852	30,169	528	1.8	29,641	32.8
Babylon, N.Y.	1893	17,823	90	0.5	17,733	29.0
Clinton, Iowa	1910	11,862	0	0	11,862	19.3
Clyde, N.Y.	1889	6,574	200	3.0	6,374	51.5
Denver, Colo.	1881	394,076	27,339	6.9	366,737	28.5
Des Moines, Iowa	1884	1,488,250	4,895	0.3	1,483,355	23.6
Detroit, Mich.	1840	5,126,948	114,112	2.2	5,012,836	21.1
Huntington, W.Va.	1887	126,219	144	0.1	126,075	26.5
Jamaica, N.Y.	1887	1,518,359	12,855	0.8	1,505,504	14.0
Merrick, N.Y.	1922	29,033	0	0	29,033	13.7
Norwich, N. Y.	1881	9,332	0	0	9,332	54.6
Ottawa, Ont.	1874	126,102	560	0.4	125,542	37.7
Philadelphia, Pa.	1822	1,931,677	13,047	0.7	1,918,630	23.0
Portland, Me.	1869	375,227	42,707	11.4	332,520	23.4
Rochester (Suburban), N.Y.	1905	152,729	342	0.2	152,387	28.7
Sag Harbor, N.Y.	1889	2,250	0	0	2,250	46.1
St. Marvs, Pa.	1907	23,481	0	0	23,481	34.5
St. Paul, Minn.	1895	179,528	2,980	1.7	176,548	17.4
Scranton, Pa.	1880	47,864	1,160	2.4	46,704	45.0
Springfield, Mass.	1866	699,662	20,209	2.9	679,453	22.3
Summit, N. J.	1889	104,093	382	0.4	103,711	31.1
Syracuse (Suburban), N.Y.	1910	26,480	239	0.9	26,241	26.5
Utica, N.Y.	1849	135,949	3,175	2.3	132,774	38.6
West Palm Beach, Fla.	1894	64,557	21,644	33.5	42,913	22.8
Winnipeg, Man.	1882	244,035	20,856	8.5	223,179	27.7
TOTAL		12,872,279	287,464	2.2	12,584,815	22.0

10-in. Cast-Iron Unlined Pipe

Alexandria, Va.	1852	23,404	42	0.2	23,362	32.5
Babylon, N.Y.	1926	22,274	0	0	22,274	13.9
Clinton, Iowa	1875	562	276	49.1	286	16.4
Clyde, N.Y.	1889	1,025	0	0	1,025	51.5
Denver, Colo.	1881	109,953	18,267	16.6	91,686	46.5
Des Moines, Iowa	1896	1,355	0	0	1,355	46.5
Detroit, Mich.	1854	292,189	25,599	8.8	266,590	42.4
Huntington, W.Va.	1887	31,996	0	0	31,996	39.3
Jamaica, N.Y.	1887	30,420	2,078	6.8	28,342	33.9
Norwich, N.Y.	1881	8,207	0	0	8,207	53.7
Ottawa, Ont.	1908	10,865	0	0	10,865	27.5
Philadelphia, Pa.	1821	643,038	16,268	2.5	626,770	54.4
Portland, Me.	1869	38,752	1,551	4.0	37,201	34.5
Rochester (Suburban), N.Y.	1908	4,800	0	0	4,800	32.5
Sag Harbor, N.Y.	1889	2,871	0	0	2,871	51.5
Scranton, Pa.	1870	36,834	35	0.1	36,799	45.5

10-in. Cast-Iron Unlined Pipe (contd.)

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Springfield, Mass.	1873	88,893	2,629	3.0	86,264	23.6
Summit, N.J.	1889	57,787	12	0.0	57,775	44.1
Syracuse (Suburban), N.Y.	1910	2,023	0	0	2,023	30.5
Utica, N.Y.	1849	37,773	2,399	6.4	35,374	50.3
West Palm Beach, Fla.	1921	5,635	0	0	5,635	16.9
Winnipeg, Man.	1882	165,145	532	0.3	164,613	31.4
TOTAL		1,615,801	69,688	4.3	1,546,113	44.5

12-in. Cast-Iron Unlined Pipe

Alexandria, Va.	1885	22,017	42	0.2	21,975	25.8
Babylon, N.Y.	1926	779	0	0	779	12.8
Clinton, Iowa	1922	4,266	0	0	4,266	15.7
Denver, Colo.	1881	695,650	61,203	8.8	634,447	28.0
Des Moines, Iowa	1888	185,711	370	0.2	185,341	26.1
Detroit, Mich.	1860	1,184,995	22,224	1.9	1,162,771	19.9
Huntington, W.Va.	1887	58,607	199	0.3	58,408	29.1
Jamaica, N.Y.	1887	310,243	6,606	2.1	303,637	15.1
Merrick, N.Y.	1926	61,349	56	0.1	61,293	12.4
Norwich, N.Y.	1881	14,219	1,717	12.1	12,502	48.3
Ottawa, Ont.	1874	80,221	550	0.7	79,671	35.8
Philadelphia, Pa.	1825	1,156,658	46,306	4.0	1,110,352	32.9
Portland, Me.	1869	157,926	8,599	5.4	149,327	37.0
Rochester (Suburban), N.Y.	1905	44,332	252	0.6	44,080	34.0
St. Paul, Minn.	1883	396,331	5,949	1.5	390,382	36.8
Scranton, Pa.	1891	98,611	20	0.0	98,591	32.7
Springfield, Mass.	1865	104,052	5,686	5.5	98,366	34.2
Summit, N. J.	1899	33,430	0	0	33,430	29.3
Syracuse (Suburban), N.Y.	1910	15,573	146	0.9	15,427	28.9
Utica, N.Y.	1849	93,611	847	0.9	92,764	28.3
West Palm Beach, Fla.	1922	2,670	0	0	2,670	18.5
Winnipeg, Man.	1882	95,466	3,458	3.6	92,008	28.4
TOTAL		4,816,717	164,230	3.4	4,652,487	27.5

14-in. Cast-Iron Unlined Pipe

Denver, Colo.	1888	34,840	892	2.6	33,948	50.0
Des Moines, Iowa	1941	36,477	0	0	36,477	1.5
Jamaica, N. Y.	1910	10,092	0	0	10,092	22.4
Norwich, N.Y.	1902	7,002	0	0	7,002	38.5
Scranton, Pa.	1884	8,766	968	11.0	7,798	44.2
West Palm Beach, Fla.	1914	4,585	0	0	4,585	26.5
Winnipeg, Man.	1889	40,268	45	0.1	40,223	33.6
TOTAL		142,030	1,905	1.3	140,125	29.0

SURVIVAL AND RETIREMENT

15-in. Cast-Iron Unlined Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Denver, Colo.	1872	6,177	0	0	6,177	68.5
Ottawa, Ont.	1874	30,476	144	0.5	30,332	52.6
TOTAL		36,653	144	0.4	36,509	55.3

16-in. Cast-Iron Unlined Pipe

Alexandria, Va.	1885	3,329	0	0	3,329	46.7
Denver, Colo.	1888	113,439	9,797	8.6	103,642	33.9
Des Moines, Iowa	1883	34,403	365	1.1	34,038	25.5
Detroit, Mich.	1854	527,810	13,029	2.5	514,781	21.7
Huntington, W.Va.	1906	9,768	0	0	9,768	24.7
Jamaica, N.Y.	1904	73,607	944	1.3	72,663	14.3
Norwich, N.Y.	1902	1,734	0	0	1,734	37.5
Ottawa, Ont.	1912	37,166	0	0	37,166	15.3
Philadelphia, Pa.	1829	290,803	4,076	1.4	286,727	42.0
Portland, Me.	1869	31,163	6,790	21.8	24,373	38.4
St. Paul, Minn.	1883	263,902	8,054	3.1	255,848	37.6
Scranton, Pa.	1880	92,866	2,620	2.8	90,246	41.3
Springfield, Mass.	1865	84,232	3,587	4.3	80,645	30.7
Summit, N.J.	1899	31,952	0	0	31,952	22.0
Syracuse (Suburban), N.Y.	1910	55,603	11,655	21.0	43,948	28.6
Utica, N.Y.	1886	31,979	0	0	31,979	36.1
West Palm Beach, Fla.	1920	8,251	2,530	30.7	5,721	17.2
Winnipeg, Man.	1899	18,868	0	0	18,868	36.9
TOTAL		1,710,875	63,447	3.7	1,647,428	30.6

18-in. Cast-Iron Unlined Pipe

Denver, Colo.	1888	26,511	354	1.3	26,157	39.1
Detroit, Mich.	1883	103	103	100.0	0	—
Jamaica, N.Y.	1930	72	0	0	72	10.5
Norwich, N.Y.	1902	784	0	0	784	38.5
Ottawa, Ont.	1915	8,924	0	0	8,924	24.8
Philadelphia, Pa.	1890	2,031	0	0	2,031	50.5
Scranton, Pa.	1872	51,432	1,113	2.2	50,319	44.0
Summit, N.J.	1912	2,233	0	0	2,233	28.5
Winnipeg, Man.	1899	39,863	1,113	2.8	38,750	26.3
TOTAL		131,953	2,683	2.0	129,270	36.2

20-in. Cast-Iron Unlined Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Alexandria, Va.	1885	4,246	0	0	4,246	51.1
Denver, Colo.	1880	47,381	12,137	25.6	35,244	24.4
Des Moines, Iowa	1883	45,715	1,216	2.7	44,499	17.2
Detroit, Mich.	1883	348	61	17.5	287	44.5
Huntington, W.Va.	1921	4,469	0	0	4,469	19.5
Jamaica, N.Y.	1934	1,332	0	0	1,332	6.5
Ottawa, Ont.	1916	5,235	0	0	5,235	20.2
Philadelphia, Pa.	1819	326,411	43,858	13.4	282,553	49.9
Portland, Me.	1887	43,404	521	1.2	42,883	26.8
Rochester (Suburban), N.Y.	1905	139,920	2,345	1.7	137,575	25.3
St. Paul, Minn.	1884	66,490	2,831	4.3	63,659	42.8
Scranton, Pa.	1891	29,859	40	0.1	29,819	37.7
Springfield, Mass.	1890	7,913	10	0.1	7,903	35.5
Summit, N.J.	1912	4,143	0	0	4,143	28.4
Syracuse (Suburban), N.Y.	1910	77,904	17	0.0	77,887	30.4
Utica, N.Y.	1885	54,776	1,371	2.5	53,405	41.2
West Palm Beach, Fla.	1921	1,160	0	0	1,160	19.5
Winnipeg, Man.	1899	4,200	148	3.5	4,052	41.6
TOTAL		864,906	64,555	7.5	800,351	37.2

22-in. Cast-Iron Unlined Pipe

Philadelphia, Pa.	1819	2,660	2,660	100.0	0	—
TOTAL		2,660	2,660	100.0	0	—

24-in. Cast-Iron Unlined Pipe

Denver, Colo.	1890	121,032	4,523	3.7	116,509	30.2
Des Moines, Iowa	1922	6,409	9	0.1	6,400	19.0
Detroit, Mich.	1854	579,381	19,518	3.4	559,863	22.5
Jamaica, N.Y.	1935	268	0	0	268	5.5
Ottawa, Ont.	1890	12,747	0	0	12,747	30.2
Philadelphia, Pa.	1871	119,523	73	0.1	119,450	17.1
Portland, Me.	1879	3,622	176	4.9	3,446	24.4
Rochester (Suburban), N.Y.	1926	294	0	0	294	14.5
St. Paul, Minn.	1883	31,992	249	0.8	31,743	37.1
Scranton, Pa.	1872	48,482	1,933	4.0	46,549	46.9
Springfield, Mass.	1874	44,945	602	1.3	44,343	28.3
Summit, N.J.	1917	14,186	0	0	14,186	23.5
Syracuse (Suburban), N.Y.	1910	87,770	18	0.0	87,752	15.0
Utica, N.Y.	1885	112,694	186	0.2	112,508	31.8
Winnipeg, Man.	1919	11	0	0.0	11	23.5
TOTAL		1,183,356	27,287	2.3	1,156,069	24.7

30-in. Cast-Iron Unlined Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Denver, Colo.	1888	77,024	1,568	2.0	75,456	27.7
Des Moines, Iowa	1920	18,004	2,226	12.4	15,778	10.3
Detroit, Mich.	1858	137,414	2,560	1.9	134,854	30.5
Ottawa, Ont.	1916	2,046	0	0	2,046	24.2
Philadelphia, Pa.	1819	309,830	42,889	13.8	266,941	51.3
Portland, Me.	1900	34,728	4,133	11.9	30,595	38.8
St. Paul, Minn.	1884	61,678	0	0	61,678	35.1
Scranton, Pa.	1893	33,919	40	0.1	33,879	42.9
Springfield, Mass.	1874	51,832	1,669	3.2	50,163	45.2
Utica, N.Y.	1924	5,615	0	0	5,615	16.5
TOTAL		732,090	55,085	7.5	677,005	40.3

36-in. Cast-Iron Unlined Pipe

Denver, Colo.	1884	50,829	1,496	2.9	49,333	17.2
Detroit, Mich.	1890	225,126	404	0.2	224,722	15.8
Ottawa, Ont.	1916	6,853	0	0	6,853	24.3
Philadelphia, Pa.	1830	114,653	4,693	4.1	109,960	45.4
St. Paul, Minn.	1884	20,653	685	3.3	19,968	36.2
Scranton, Pa.	1893	46,673	0	0	46,673	38.2
Springfield, Mass.	1894	31,048	199	0.6	30,849	40.2
TOTAL		495,835	7,477	1.5	488,358	27.2

39.37-in. Cast-Iron Unlined Pipe

Denver, Colo.	1924	2,286	0	0	2,286	16.5
TOTAL		2,286	0	0	2,286	16.5

41.34-in. Cast-Iron Unlined Pipe

Denver, Colo.	1924	2,483	0	0	2,483	16.5
TOTAL		2,483	0	0	2,483	16.5

42-in. Cast-Iron Unlined Pipe

Denver, Colo.	1899	684	0	0	684	32.1
Detroit, Mich.	1875	184,992	2,444	1.3	182,548	36.8
Portland, Me.	1912	75,749	0	0	75,749	28.5
St. Paul, Minn.	1923	11,237	0	0	11,237	18.5
Springfield, Mass.	1909	2,254	75	3.3	2,179	33.5
Utica, N.Y.	1912	900	0	0	900	28.5
TOTAL		275,816	2,519	0.9	273,297	33.7

48-in. Cast-Iron Unlined Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Denver, Colo.	1910	2,472	1,743	70.5	729	20.6
Detroit, Mich.	1908	179,138	1,444	0.8	177,694	28.3
Philadelphia, Pa.	1861	291,740	19,074	6.5	272,666	39.3
Portland, Me.	1925	134	0	0	134	15.5
Scranton, Pa.	1897	5,443	0	0	5,443	32.9
TOTAL		478,927	22,261	4.6	456,666	34.9

60-in. Cast-Iron Unlined Pipe

Denver, Colo.	1911	67	0	0	67	29.5
Philadelphia, Pa.	1921	4,830	0	0	4,830	18.4
TOTAL		4,897	0	0	4,897	18.6

72-in. Cast-Iron Unlined Pipe

Philadelphia, Pa.	1930	13,514	0	0	13,514	10.5
TOTAL		13,514	0	0	13,514	10.5

93-in. Cast-Iron Unlined Pipe

Philadelphia, Pa.	1930	13,150	0	0	13,150	10.5
TOTAL		13,150	0	0	13,150	10.5

2-in. Cast-Iron Cement-Lined Pipe

Alexandria, Va.	1930	27,392	3,032	11.1	24,360	6.3
Babylon, N.Y.	1930	848	0	0	848	9.8
Clinton, Iowa	1931	5,411	0	0	5,411	2.3
Huntington, W.Va.	1929	58,756	799	1.4	57,957	3.5
St. Marys, Pa.	1931	9,800	0	0	9,800	2.6
Summit, N.J.	1934	5,490	0	0	5,490	2.8
West Palm Beach, Fla.*	1938	11,041	0	0	11,041	2.5
TOTAL		118,738	3,831	3.2	114,907	3.9

* 2½-inch.

SURVIVAL AND RETIREMENT

4-in. Cast-Iron Cement-Lined Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Babylon, N.Y.	1931	30	0	0	30	8.6
Merrick, N.Y.	1931	99	0	0	99	5.7
Norwich, N.Y.	1930	203	0	0	203	7.1
St. Marys, Pa.	1931	1,422	0	0	1,422	6.1
Scranton, Pa.	1935	126	0	0	126	2.6
Summit, N.J.	1928	803	0	0	803	4.4
West Palm Beach, Fla.	1929	1,069	134	12.5	935	9.0
TOTAL		3,752	134	3.6	3,618	6.4

6-in. Cast-Iron Cement-Lined Pipe

Alexandria, Va.	1930	63,096	0	0	63,096	3.7
Babylon, N.Y.	1930	14,456	0	0	14,456	4.4
Clinton, Iowa	1929	18,445	0	0	18,445	7.1
Clyde, N.Y.	1929	2,271	0	0	2,271	8.8
Huntington, W.Va.	1926	4,764	0	0	4,764	7.6
Merrick, N.Y.	1931	70,998	0	0	70,998	6.1
Norwich, N.Y.	1930	2,560	0	0	2,560	5.6
Portland, Me.	1925	59,017	141	0.2	58,876	10.8
Rochester (Suburban) N.Y.	1927	72,973	6	0.0	72,967	9.3
Sag Harbor, N.Y.	1936	2,672	0	0	2,672	11.8
St. Marys, Pa.	1928	10,774	0	0	10,774	8.1
Scranton, Pa.	1925	3,034	0	0	3,034	9.2
Summit, N.J.	1927	454,491	207	0.0	454,284	8.8
Syracuse (Suburban) N.Y.	1928	98,861	82	0.1	98,779	9.5
Utica, N.Y.	1934	5,069	0	0	5,069	5.6
West Palm Beach, Fla.	1925	165,282	475	0.3	164,807	13.3
TOTAL		1,048,763	911	0.1	1,047,852	9.1

8-in. Cast-Iron Cement-Lined Pipe

Alexandria, Va.	1930	18,693	0	0	18,693	3.1
Babylon, N.Y.	1930	1,393	0	0	1,393	8.8
Clinton, Iowa	1930	8,963	0	0	8,963	5.1
Clyde, N.Y.	1930	246	0	0	246	10.5
Detroit, Mich.	1941	1,845	0	0	1,845	1.5
Huntington, W.Va.	1925	94,837	0	0	94,837	11.1
Merrick, N.Y.	1931	28,446	0	0	28,446	7.9
Norwich, N.Y.	1936	1,301	0	0	1,301	3.7
Portland, Me.	1926	104,825	18	0.0	104,807	11.6
Rochester (Suburban) N.Y.	1927	26,208	502	1.9	25,706	9.8
St. Marys, Pa.	1927	10,107	0	0	10,107	14.5
Scranton, Pa.	1934	1,044	0	0	1,044	3.9
Summit, N.J.	1927	78,520	412	0.5	78,108	8.1

8-in. Cast-Iron Cement-Lined Pipe (contd.)

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Syracuse (Suburban) N.Y.	1928	23,307	7	0.0	23,300	10.1
Utica, N.Y.	1938	26	0	0	26	2.5
West Palm Beach, Fla.	1924	112,462	7,550	6.7	104,912	12.2
TOTAL		512,223	8,489	1.7	503,734	10.3

10-in. Cast-Iron Cement-Lined Pipe

Merrick, N.Y.	1937	49	0	0	49	3.5
Portland, Me.	1928	320	0	0	320	11.6
Summit, N.J.	1930	12	0	0	12	10.5
West Palm Beach, Fla.	1925	15,175	0	0	15,175	15.0
TOTAL		15,556	0	0	15,556	14.9

12-in. Cast-Iron Cement-Lined Pipe

Alexandria, Va.	1931	2,061	0	0	2,061	2.8
Huntington, W.Va.	1926	30,071	0	0	30,071	12.9
Merrick, N.Y.	1931	7,820	0	0	7,820	8.5
Norwich, N.Y.	1938	1,514	0	0	1,514	2.5
Portland, Me.	1927	49,644	0	0	49,644	11.8
Rochester (Suburban) N.Y.	1928	8,778	0	0	8,778	10.8
Summit, N.J.	1927	58,508	0	0	58,508	7.8
Syracuse (Suburban) N.Y.	1929	31,558	135	0.4	31,423	10.5
Utica, N.Y.	1934	1,216	0	0	1,216	6.0
West Palm Beach, Fla.	1925	31,884	0	0	31,884	12.2
TOTAL		223,054	135	0.1	222,919	10.4

16-in. Cast-Iron Cement-Lined Pipe

Huntington, W.Va.	1927	6,355	0	0	6,355	13.5
Portland, Me.	1926	19,666	0	0	19,666	11.3
Rochester (Suburban), N.Y.	1931	3,481	21	0.6	3,460	6.7
Scranton, Pa.	1933	98	0	0	98	7.0
Summit, N.J.	1927	40,728	0	0	40,728	8.0
West Palm Beach, Fla.	1925	28,424	0	0	28,424	11.1
TOTAL		98,752	21	0.0	98,731	9.9

SURVIVAL AND RETIREMENT

20-in. Cast-Iron Cement-Lined Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Huntington, W.Va.	1930	2,796	0	0	2,796	10.5
Portland, Me.	1926	9,571	0	0	9,571	11.2
Rochester (Suburban), N.Y.	1930	6,442	0	0	6,442	10.1
West Palm Beach, Fla.	1925	17,475	0	0	17,475	14.4
TOTAL		36,284	0	0	36,284	12.5

24-in. Cast-Iron Cement-Lined Pipe

Detroit, Mich.	1941	495	0	0	495	1.5
Portland, Me.	1927	12,722	0	0	12,722	10.9
Rochester (Suburban), N.Y.	1930	4,530	0	0	4,530	10.5
Summit, N.J.	1928	6,297	0	0	6,297	12.5
West Palm Beach, Fla.	1926	11,361	0	0	11,361	14.2
TOTAL		35,405	0	0	35,405	12.1

30-in. Cast-Iron Cement-Lined Pipe

Portland, Me.	1927	5,355	0	0	5,355	13.5
West Palm Beach, Fla.	1925	645	0	0	645	15.5
TOTAL		6,000	0	0	6,000	13.7

8-in. Cast-Iron Bituminous-Lined Pipe

Portland, Me.	1939	15,229	0	0	15,229	1.5
TOTAL		15,229	0	0	15,229	1.5

12-in. Cast-Iron Bituminous-Lined Pipe

Portland, Me.	1939	8,641	0	0	8,641	1.5
TOTAL		8,641	0	0	8,641	1.5

16-in. Cast-Iron Bituminous-Lined Pipe

Portland, Me.	1939	4,330	0	0	4,330	1.5
TOTAL		4,330	0	0	4,330	1.5

¾-in. Wrought-Iron Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Clinton, Iowa	1909	237	0	0	237	30.5
Huntington, W.Va.	1888	246	246	100.0	0	—
Summit, N.J.	1902	2,533	1,658	65.5	875	32.9
Utica, N.Y.	1913	63	0	0	63	27.5
TOTAL		3,079	1,904	61.8	1,175	32.1

1-in. Wrought-Iron Pipe

Denver, Colo.	1895	10,012	3,997	39.9	6,015	31.7
Huntington, W.Va.	1887	2,310	2,082	90.1	228	34.0
St. Marys, Pa.	1900	305	0	0	305	41.5
Summit, N.J.	1891	9,508	6,531	68.7	2,977	35.7
Utica, N.Y.	1891	442	409	92.5	33	49.5
TOTAL		22,577	13,019	57.7	9,558	33.4

1½-in. Wrought-Iron Pipe

Clinton, Iowa	1912	598	598	100.0	0	—
Denver, Colo.	1890	13,864	8,406	60.6	5,458	32.7
Huntington, W.Va.	1888	556	195	35.1	361	22.9
St. Marys, Pa.	1900	1,395	750	53.8	645	35.5
TOTAL		16,413	9,949	60.6	6,464	32.4

1½-in. Wrought-Iron Pipe

Alexandria, Va.	1852	3,131	1,850	59.1	1,281	15.9
Denver, Colo.	1890	24,046	15,072	62.7	8,974	31.3
Huntington, W.Va.	1887	3,166	2,796	88.3	370	43.2
St. Marys, Pa.	1900	261	0	0	261	41.5
Summit, N.J.	1896	10,094	6,236	61.8	3,858	35.1
Utica, N.Y.	1860	1,210	1,210	100.0	0	—
TOTAL		41,908	27,164	64.8	14,744	31.4

2-in. Wrought-Iron Pipe

Alexandria, Va.	1852	9,366	6,613	70.6	2,753	15.5
Clinton, Iowa	1890	22,400	16,655	74.4	5,745	25.8
Denver, Colo.	1884	526,585	239,524	45.5	287,061	20.6
Huntington, W.Va.	1887	144,444	47,877	33.1	96,567	31.5
St. Marys, Pa.	1898	6,242	3,994	64.0	2,248	38.1

2-in. Wrought-Iron Pipe (contd.)

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Scranton, Pa.	1898	2,000	0	0	2,000	40.9
Summit, N.J.	1890	36,038	20,337	56.4	15,701	40.0
Utica, N.Y.	1851	1,702	1,239	72.8	463	29.4
TOTAL		748,777	336,239	44.9	412,538	24.1

2½-in. Wrought-Iron Pipe

Alexandria, Va.	1866	600	600	100.0	0	—
Denver, Colo.	1907	1,090	275	25.2	815	33.5
Huntington, W.Va.	1911	185	0	0	185	29.5
Utica, N.Y.	1902	2,877	2,877	100.0	0	—
TOTAL		4,752	3,752	79.0	1,000	32.8

3-in. Wrought-Iron Pipe

Alexandria, Va.	1925	1,643	0	0	1,643	15.5
Huntington, W.Va.	1904	1,273	1,213	95.3	60	29.5
St. Paul, Minn.	1921	1,831	100	5.5	1,731	16.4
TOTAL		4,747	1,313	27.7	3,434	16.2

4-in. Wrought-Iron Pipe

St. Marys, Pa.	1889	6,309	4,619	73.1	1,690	43.5
TOTAL		6,309	4,619	73.1	1,690	43.5

5-in. Wrought-Iron Pipe

St. Marys, Pa.	1900	876	0	0	876	41.5
TOTAL		876	0	0	876	41.5

6-in. Wrought-Iron Pipe

San Francisco, Calif.	1915	4,604	795	17.3	3,809	24.6
St. Marys, Pa.	1897	22,969	511	2.2	22,458	42.6
Summit, N.J.	1889	348	348	100.0	0	—
TOTAL		27,921	1,654	5.9	26,267	40.0

8-in. Wrought-Iron Pipe

City	Year of First Installation	No of Feet Installed	Retired		In Service	
			No of Feet	Percent- age of Total Installed	No of Feet	Average Age, yr.
Huntington, W.Va.	1930	486	0	0	486	10.5
San Francisco, Calif.	1920	1,510	1,510	100.0	0	—
Scranton, Pa.	1912	120	0	0	120	28.5
TOTAL		2,116	1,510	71.4	606	14.1

10-in. Wrought-Iron Pipe

Scranton, Pa.	1916	125	125	100.0	0	—
Syracuse (Suburban), N.Y.	1910	105	0	0	105	30.5
TOTAL		230	125	54.3	105	30.5

12-in. Wrought-Iron Pipe

Norwich, N.Y.	1936	137	0	0	137	4.5
San Francisco, Calif.	1900	6,555	0	0	6,555	30.1
TOTAL		6,692	0	0	6,692	29.6

13-in. Wrought-Iron Pipe

San Francisco, Calif.	1882	850	394	46.4	456	50.5
TOTAL		850	394	46.4	456	50.5

16-in. Wrought-Iron Pipe

San Francisco, Calif.	1895	870	870	100.0	0	—
Scranton, Pa.	1897	110	110	100.0	0	—
TOTAL		980	980	100.0	0	—

18-in. Wrought-Iron Pipe

San Francisco, Calif.	1887	4,475	4,475	100.0	0	—
TOTAL		4,475	4,475	100.0	0	—

22-in. Wrought-Iron Pipe

San Francisco, Calif.	1862	63,652	32,529	51.1	31,123	53.5
TOTAL		62,652	32,529	51.1	31,123	53.5

SURVIVAL AND RETIREMENT

23-in. Wrought-Iron Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
San Francisco, Calif.	1891	6,215	72	1.2	6,143	49.5
TOTAL		6,215	72	1.2	6,143	49.5

30-in. Wrought-Iron Pipe

San Francisco, Calif.	1863	247,468	122,735	41.9	124,733	41.2
Utica, N.Y.	1913	500	0	0	500	27.5
TOTAL		247,968	122,735	49.5	125,233	41.1

33-in. Wrought-Iron Pipe

San Francisco, Calif.	1885	2,409	0	0	2,409	55.5
TOTAL		2,409	0	0	2,409	55.5

36-in. Wrought-Iron Pipe

Detroit, Mich.	1931	4,688	0	0	4,688	11.5
San Francisco, Calif.	1885	149,899	68,267	45.5	81,632	49.7
TOTAL		154,587	68,267	44.2	86,320	47.6

37-in. Wrought-Iron Pipe

San Francisco, Calif.	1885	14,300	2,425	17.0	11,875	51.4
TOTAL		14,300	2,425	17.0	11,875	51.4

42-in. Wrought-Iron Pipe

Detroit, Mich.	1932	1,072	0	0	1,072	10.5
TOTAL		1,072	0	0	1,072	10.5

44-in. Wrought-Iron Pipe

San Francisco, Calif.	1885	133,824	11,546	8.6	122,278	52.1
TOTAL		133,824	11,546	8.6	122,278	52.1

54-in. Wrought-Iron Pipe

Detroit, Mich.	1929	17,696	0	0	17,696	13.0
San Francisco, Calif.	1891	17,115	0	0	17,115	36.8
TOTAL		34,811	0	0	34,811	24.7

66-in. Wrought-Iron Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Detroit, Mich.	1930	14,548	0	0	14,548	12.5
TOTAL		14,548	0	0	14,548	12.5

 $\frac{1}{2}$ -in. Steel Pipe

Huntington, W.Va.	1920	470	0	0	470	20.5
TOTAL		470	0	0	470	20.5

 $\frac{3}{4}$ -in. Steel Pipe

Alexandria, Va.	1923	349	0	0	349	16.8
Huntington, W.Va.	1920	5,607	0	0	5,607	6.9
Springfield, Mass.*	1871	1,069	1,069	100.0	0	—
Summit, N.J.	1903	1,661	1,581	95.2	80	15.5
TOTAL		8,686	2,650	30.5	6,036	7.6

1-in. Steel Pipe

Alexandria, Va.	1924	266	0	0	266	16.5
Huntington, W.Va.	1911	15,670	4,304	27.5	11,366	20.5
Scranton, Pa.	1927	2,705	222	8.2	2,483	5.0
Springfield, Mass.*	1873	24,469	14,797	60.5	9,672	17.0
Summit, N.J.	1923	760	177	23.3	583	13.4
Utica, N.Y.	1913	98	0	0	98	27.5
TOTAL		43,968	19,500	44.4	24,468	17.4

1½-in. Steel Pipe

Alexandria, Va.	1923	1,280	473	37.0	807	16.7
Huntington, W.Va.	1911	6,376	0	0	6,376	20.6
Scranton, Pa.	1920	1,086	30	2.8	1,056	9.1
Springfield, Mass.*	1870	56,897	30,792	54.1	26,105	14.7
Summit, N.J.	1923	102	0	0	102	17.5
TOTAL		65,741	31,295	47.6	34,446	15.7

* Wrought-iron and steel.

1½-in. Steel Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr
Huntington, W.Va.	1911	4,109	355	8.6	3,754	20.9
Scranton, Pa.	1909	3,918	0	0	3,918	6.0
Springfield, Mass.*	1883	32,007	16,797	52.5	15,210	15.5
Summit, N.J.	1924	1,492	0	0	1,492	10.8
TOTAL		41,526	17,152	41.3	24,374	14.5

2-in. Steel Pipe

Alexandria, Va.	1918	12,248	1,363	11.1	10,885	15.8
Clinton, Iowa	1912	57,316	7,304	12.7	50,012	17.1
Huntington, W.Va.	1911	251,160	32,985	13.1	218,175	19.4
Scranton, Pa.	1914	12,065	35	0.3	12,030	11.8
Springfield, Mass.*	1875	107,078	59,396	55.5	47,682	17.3
Summit, N.J.	1924	5,964	188	3.2	5,776	13.4
Utica, N.Y.	1913	128	0	0	128	27.5
TOTAL		445,959	101,271	22.7	344,688	18.3

2½-in. Steel Pipe

Alexandria, Va.	1921	1,373	258	18.8	1,115	14.5
Huntington, W.Va.	1911	185	0	0	185	29.5
Scranton, Pa.	1928	22	0	0	22	12.5
Springfield, Mass.*	1939	159	0	0	159	3.5
Summit, N.J.	1924	190	190	100.0	0	—
TOTAL		1,929	448	23.2	1,481	15.2

3-in. Steel Pipe

Alexandria, Va.	1924	1,649	0	0	1,649	14.2
Huntington, W.Va.	1911	1,376	235	17.1	1,141	14.1
Scranton, Pa.	1928	8	0	0	8	12.5
Springfield, Mass.*	1877	2,016	2,016	100.0	0	—
TOTAL		5,049	2,251	44.6	2,798	14.2

4-in. Steel Pipe

Alexandria, Va.	1913	4,249	2,676	63.0	1,573	16.5
Huntington, W.Va.	1920	2,064	0	0	2,064	18.5
TOTAL		6,313	2,676	42.4	3,637	17.6

* Wrought-iron and steel.

6-in. Steel Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Scranton, Pa.	1895	426	0	0	426	4.7
Utica, N.Y.*	1940	470	0	0	470	0.5
TOTAL		896	0	0	896	2.5

8-in. Steel Pipe

Sag Harbor, N.Y.	1897	1,025	104	10.1	921	43.1
Scranton, Pa.	1893	255	0	0	255	46.7
Utica, N.Y.*	1937	45	0	0	45	3.5
TOTAL		1,325	104	7.8	1,221	42.4

10-in. Steel Pipe

San Francisco, Calif.	1938	9,580	0	0	9,580	2.5
Scranton, Pa.	1928	125	0	0	125	12.5
Springfield, Mass.	1931	28	0	0	28	11.5
TOTAL		9,733	0	0	9,733	2.7

12-in. Steel Pipe

Des Moines, Iowa	1940	742	0	0	742	2.5
Detroit, Mich.	1920	28,064	9,834	35.0	18,230	21.4
Huntington, W.Va.	1923	444	0	0	444	17.5
Philadelphia, Pa.	1930	2,801	0	0	2,801	9.8
TOTAL		32,051	9,834	30.7	22,217	19.2

16-in. Steel Pipe

Denver, Colo.	1933	300	0	0	300	7.5
Detroit, Mich.	1922	26,339	5,596	21.2	20,743	20.1
Philadelphia, Pa.	1935	120	0	0	120	5.5
San Francisco, Calif.	1888	40,353	13,976	34.6	26,377	14.4
Springfield, Mass.	1929	253	0	0	253	12.1
TOTAL		67,365	19,572	29.1	47,793	16.8

18-in. Steel Pipe

Springfield, Mass.	1940	13,144	0	0	13,144	2.5
TOTAL		13,144	0	0	13,144	2.5

* Bituminous-lined.

20-in. Steel Pipe

City	Year of First Installation	No of Feet Installed	Retired		In Service	
			No of Feet	Percentage of Total Installed	No of Feet	Average Age, yr.
Rochester (Suburban), N Y.	1928	528	0	0	528	12.5
Philadelphia, Pa.	1908	151	0	0	151	32.5
San Francisco, Calif.	1926	65,728	0	0	65,728	9.2
St. Paul, Minn.	1938	8,409	0	0	8,409	3.3
Springfield, Mass.	1926	443	0	0	443	5.3
TOTAL		75,259	0	0	75,259	8.6

21-in. Steel Pipe

Utica, N.Y.	1934	128	0	0	128	6.5
TOTAL		128	0	0	128	6.5

22-in. Steel Pipe

San Francisco, Calif.	1902	13,740	0	0	13,740	38.3
TOTAL		13,740	0	0	13,740	38.3

23½-in. Steel Pipe

San Francisco, Calif.	1923	9,516	429	4.5	9,087	17.4
TOTAL		9,516	429	4.5	9,087	17.4

24-in. Steel Pipe

Denver, Colo.	1911	2,763	0	0	2,763	27.8
Detroit, Mich.	1921	10,402	7,542	72.5	2,860	20.8
St. Paul, Minn.	1938	2,621	0	0	2,621	3.5
San Francisco, Calif.	1926	26,443	0	0	26,443	8.5
Springfield, Mass.	1915	71	0	0	71	26.1
TOTAL		42,300	7,542	17.8	34,758	10.7

28-in. Steel Pipe

San Francisco, Calif.	1936	7,480	0	0	7,480	4.5
TOTAL		7,480	0	0	7,480	4.5

30-in. Steel Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Denver, Colo.	1928	6,100	2,936	48.1	3,164	10.5
Des Moines, Iowa	1936	1,826	0	0	1,826	6.5
Detroit, Mich.	1928	75	0	0	75	14.5
Philadelphia, Pa.	1930	1,590	0	0	1,590	10.0
St. Paul, Minn.	1938	8,014	0	0	8,014	3.5
San Francisco, Calif.	1915	18,561	0	0	18,561	10.9
Springfield, Mass.	1909	2,163	0	0	2,163	33.5
Utica, N.Y.	1913	500	0	0	500	27.5
TOTAL		38,829	2,936	7.6	35,893	10.5

34-in. Steel Pipe

Denver, Colo.	1893	4,162	0	0	4,162	23.1
TOTAL		4,162	0	0	4,162	23.1

36-in. Steel Pipe

Denver, Colo.	1938	244	0	0	244	2.5
Detroit, Mich.	1922	5,572	0	0	5,572	19.4
Philadelphia, Pa.	1921	1,014	0	0	1,014	18.5
Portland, Me.	1931	3,730	0	0	3,730	9.5
San Francisco, Calif.	1924	69,651	0	0	69,651	5.2
Springfield, Mass.	1910	3,822	0	0	3,822	15.1
TOTAL		84,033	0	0	84,033	6.9

40-in. Steel Pipe

Ottawa, Ont.	1890	6,006	0	0	6,006	50.5
TOTAL		6,006	0	0	6,006	50.5

42-in. Steel Pipe

Denver, Colo.	1938	45,613	0	0	45,613	2.5
Detroit, Mich.	1925	20,462	0	0	20,462	15.7
Ottawa, Ont.	1912	5,450	3,050	56.0	2,400	28.5
Springfield, Mass.	1909	61,930	17	0.0	61,913	33.3
TOTAL		133,455	3,067	2.3	130,388	19.7

SURVIVAL AND RETIREMENT

44-in. Steel Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Detroit, Mich.	1926	20,893	0	0	20,893	16.5
San Francisco, Calif.	1924	56,592	0	0	56,592	9.1
TOTAL		77,485	0	0	77,485	11.1

45-in. Steel Pipe

Denver, Colo.	1910	8,784	3,345	38.1	5,439	15.5
Detroit, Mich.	1920	88,382	190	0.2	88,192	19.0
Philadelphia, Pa.	1901	31,819	0	0	31,819	23.4
San Francisco, Calif.	1931	12,354	0	0	12,354	9.4
Springfield, Mass.	1929	18,309	0	0	18,309	13.5
TOTAL		159,648	3,535	2.2	156,113	18.4

50-in. Steel Pipe

Detroit, Mich.	1927	2,633	0	0	2,633	15.5
TOTAL		2,633	0	0	2,633	15.5

51-inch Steel Pipe

Denver, Colo.	1938	6,344	0	0	6,344	2.5
Ottawa, Ont.	1918	18,890	0	0	18,890	21.7
Springfield, Mass.	1929	13	0	0	13	13.5
TOTAL		25,247	0	0	25,247	16.9

54-in. Steel Pipe

Denver, Colo.	1925	8,936	0	0	8,936	15.5
Detroit, Mich.	1927	594	0	0	594	14.5
San Francisco, Calif.	1928	73,873	0	0	73,873	10.9
Springfield, Mass.	1929	16,155	0	0	16,155	13.5
TOTAL		99,558	0	0	99,558	11.8

57-in. Steel Pipe

Denver, Colo.	1938	12,581	0	0	12,581	2.5
TOTAL		12,581	0	0	12,581	2.5

60-in. Steel Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Denver, Colo.	1911	1,179	0	0	1,179	28.7
Detroit, Mich.	1926	36,437	0	0	36,437	15.5
Philadelphia, Pa.	1921	2,739	0	0	2,739	19.5
San Francisco, Calif.	1925	191,545	0	0	191,545	9.8
Springfield, Mass.	1932	71	0	0	71	10.5
TOTAL		231,971	0	0	231,971	10.9

63-in. Steel Pipe

Denver, Colo.	1938	17,563	0	0	17,563	2.5
TOTAL		17,563	0	0	17,563	2.5

66-in. Steel Pipe

Denver, Colo.	1925	4,873	0	0	4,873	12.6
Detroit, Mich.	1930	7,554	0	0	7,554	11.5
San Francisco, Calif.	1935	78,896	0	0	78,896	5.5
Springfield, Mass.	1929	279	0	0	279	13.5
TOTAL		91,602	0	0	91,602	6.4

72-in. Steel Pipe

Detroit, Mich.	1927	34,457	0	0	34,457	11.5
Springfield, Mass.	1929	23	0	0	23	13.5
TOTAL		34,480	0	0	34,480	11.5

76-in. Steel Pipe

San Francisco, Calif.	1935	3,858	0	0	3,858	5.5
TOTAL		3,858	0	0	3,858	5.5

78-in. Steel Pipe

San Francisco, Calif.	1937	649	0	0	649	3.5
TOTAL		649	0	0	649	3.5

93-in. Steel Pipe

Philadelphia, Pa.	1930	5,651	0	0	5,651	10.5
TOTAL		5,651	0	0	5,651	10.5

24-in. Concrete Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr
Winnipeg, Man.	1938	3,899	0	0	3,899	4.5
TOTAL		3,899	0	0	3,899	4.5

30-in. Concrete Pipe

Denver, Colo.	1938	43,165	0	0	43,165	1.8
Portland, Me.	1939	3,942	0	0	3,942	1.5
TOTAL		47,107	0	0	47,107	1.8

36-in. Concrete Pipe

Denver, Colo.	1907	2,892	0	0	2,892	29.0
Winnipeg, Man.	1919	1,200	0	0	1,200	23.5
TOTAL		4,092	0	0	4,092	27.4

38-in. Concrete Pipe (Tunnel)

Denver, Colo.	1893	12,336	7,722	62.6	4,614	47.5
TOTAL		12,336	7,722	62.6	4,614	47.5

42-in. Concrete Pipe

Denver, Colo.	1938	23,719	0	0	23,719	2.2
Portland, Me.	1931	13,596	0	0	13,596	9.5
TOTAL		37,315	0	0	37,315	4.9

46-in. Concrete Pipe

Denver, Colo.	1940	6,968	0	0	6,968	0.5
TOTAL		6,968	0	0	6,968	0.5

48-in. Concrete Pipe

Ottawa, Ont.	1937	2,433	0	0	2,433	3.5
Portland, Me.	1931	53,202	0	0	53,202	3.8
TOTAL		55,635	0	0	55,635	3.8

54-in. Concrete Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Denver, Colo.	1921	69,915	662	0.9	69,253	13.4
TOTAL		69,915	662	0.9	69,253	13.4

57-in. Concrete Pipe

San Francisco, Calif.	1933	6,822	0	0	6,822	7.5
TOTAL		6,822	0	0	6,822	7.5

60-in. Concrete Pipe

Denver, Colo.	1930	57,722	0	0	57,722	10.5
TOTAL		57,722	0	0	57,722	10.5

62-in. Concrete Pipe

San Francisco, Calif.	1935	26,014	0	0	26,014	5.5
TOTAL		26,014	0	0	26,014	5.5

66-in. Concrete Pipe

Denver, Colo.	1925	31,471	0	0	31,471	15.5
TOTAL		31,471	0	0	31,471	15.5

69-in. Concrete Pipe

San Francisco, Calif.	1934	3,087	0	0	3,087	6.5
TOTAL		3,087	0	0	3,087	6.5

72-in. Concrete Pipe (Tunnel)

Denver, Colo.	1911	66	0	0	66	29.5
TOTAL		66	0	0	66	29.5

84-in. Concrete Pipe

Denver, Colo.	1925	619	0	0	619	15.5
TOTAL		619	0	0	619	15.5

24-in. Wood Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Denver, Colo.	1889	6,552	6,552	100.0	0	—
TOTAL		6,552	6,552	100.0	0	—

30-in. Wood Pipe

Denver, Colo.	1888	163,978	137,030	83.6	26,948	29.2
TOTAL		163,978	137,030	83.6	26,948	29.2

34-in. Wood Pipe

Denver, Colo.	1893	96,076	51,534	53.6	44,532	43.3
TOTAL		96,076	51,534	53.6	44,542	43.3

36-in. Wood Pipe

Denver, Colo.	1899	11,250	7,306	64.9	3,944	29.8
TOTAL		11,250	7,306	64.9	3,944	29.8

40-in. Wood Pipe

Denver, Colo.	1884	114,256	110,819	97.0	3,437	9.5
TOTAL		114,256	110,819	97.0	3,437	9.5

44-in. Wood Pipe

Denver, Colo.	1893	8,517	7,346	86.3	1,171	47.5
TOTAL		8,517	7,346	86.3	1,171	47.5

48-in. Wood Pipe

Denver, Colo.	1884	152,207	99,676	65.5	52,531	28.6
TOTAL		152,207	99,676	65.5	52,531	28.6

60-in. Wood Pipe

Denver, Colo.	1911	13,083	714	5.5	12,369	28.5
TOTAL		13,083	714	5.5	12,369	28.5

66-in. Wood Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Denver, Colo.	1925	65,024	12,597	19.4	52,427	12.8
TOTAL		65,024	12,597	19.4	52,427	12.8

2-in. Cement-Wrought-Iron and Kalamein Pipe

Springfield, Mass.	1865	1,610	1,610	100.0	0	—
TOTAL		1,610	1,610	100.0	0	—

3-in. Cement-Wrought-Iron and Kalamein Pipe

Springfield, Mass.	1865	51,765	51,765	100.0	0	—
TOTAL		51,765	51,765	100.0	0	—

4-in. Cement-Wrought-Iron and Kalamein Pipe

St. Paul, Minn.	1882	888	888	100.0	0	—
Springfield, Mass.	1865	19,464	19,464	100.0	0	—
TOTAL		20,352	20,352	100.0	0	—

6-in. Cement-Wrought-Iron and Kalamein Pipe

Springfield, Mass.	1865	53,737	53,737	100.0	0	—
TOTAL		53,737	53,737	100.0	0	—

8-in. Cement-Wrought-Iron and Kalamein Pipe

Springfield, Mass.	1864	31,459	31,459	100.0	0	—
TOTAL		31,459	31,459	100.0	0	—

10-in. Cement-Wrought-Iron and Kalamein Pipe

Springfield, Mass.	1866	2,485	2,485	100.0	0	—
TOTAL		2,485	2,485	100.0	0	—

12-in. Cement-Wrought-Iron and Kalamein Pipe

Springfield, Mass.	1864	17,081	17,081	100.0	0	—
TOTAL		17,081	17,081	100.0	0	—

16-in. Cement-Wrought-Iron and Kalamein Pipe

City	Year of First Installation	No. or Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, ³⁷
St. Paul, Minn.	1887	6,000	6,000	100.0	0	—
Springfield, Mass.	1874	16,206	16,206	100.0	0	—
TOTAL		22,206	22,206	100.0	0	—

18-in. Cement-Wrought-Iron and Kalamein Pipe

Scranton, Pa.	1872	3,580	3,580	100.0	0	—
TOTAL		3,580	3,580	100.0	0	—

20-in. Cement-Wrought-Iron and Kalamein Pipe

Portland, Me.	1869	72,698	47,469	65.3	25,229	71.5
Scranton, Pa.	1872	3,905	3,905	100.0	0	—
Springfield, Mass.	1874	4,365	4,365	100.0	0	—
TOTAL		80,968	55,739	68.8	25,229	71.5

24-in. Cement-Wrought-Iron and Kalamein Pipe

Portland, Me.	1879	55,632	36,253	65.2	19,379	61.5
St. Paul, Minn.	1885	7,024	7,024	100.0	0	—
Springfield, Mass.	1874	52,789	33,329	63.1	19,460	68.5
TOTAL		115,445	76,606	66.4	38,839	65.0

26-in. Cement-Wrought-Iron and Kalamein Pipe

Portland, Me.	1879	18,072	10,872	60.2	7,200	61.5
TOTAL		18,072	10,872	60.2	7,200	61.5

6-in. Asbestos-Cement Pipe

Winnipeg, Man.	1940	571	0	0	571	2.5
TOTAL		571	0	0	571	2.5

8-in. Asbestos-Cement Pipe

Detroit, Mich.	1937	1,605	0	0	1,605	4.0
Springfield, Mass.	1942	3,127	0	0	3,127	0.5
TOTAL		4,732	0	0	4,732	1.7

10-in. Asbestos-Cement Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Springfield, Mass.	1936	1,232	0	0	1,232	6.5
Winnipeg, Man.	1937	8,854	0	0	8,854	4.0
TOTAL		10,086	0	0	10,086	4.3

14-in. Asbestos-Cement Pipe

Winnipeg, Man.	1932	431	0	0	431	10.5
TOTAL		431	0	0	431	10.5

18-in. Asbestos-Cement Pipe

Winnipeg, Man.	1932	859	0	0	859	9.6
TOTAL		859	0	0	859	9.6

 $\frac{5}{8}$ -in. Lead Pipe

Utica, N.Y.	1913	28	0	0	28	27.5
TOTAL		28	0	0	28	27.5

 $\frac{3}{4}$ -in. Lead Pipe

Utica, N.Y.	1898	148	0	0	148	41.8
TOTAL		148	0	0	148	41.8

1-in. Lead Pipe

Alexandria, Va.	1923	16	0	0	16	17.5
Huntington, W.Va.	1920	418	0	0	418	18.6
Summit, N.J.	1923	62	0	0	62	13.0
TOTAL		496	0	0	496	17.9

1 $\frac{1}{2}$ -in. Lead Pipe

Alexandria, Va.	1926	18	0	0	18	14.5
TOTAL		18	0	0	18	14.5

SURVIVAL AND RETIREMENT

1-in. Copper Pipe

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Springfield, Mass.	1940	60	0	0	60	2.5
Utica, N.Y.	1935	31	0	0	31	5.5
TOTAL		91	0	0	91	3.5

1-in. Copper Pipe

Springfield, Mass.	1940	254	0	0	254	2.2
Utica, N.Y.	1935	226	0	0	226	5.5
TOTAL		480	0	0	480	3.8

1½-in. Copper Pipe

Springfield, Mass.	1941	291	0	0	291	1.5
TOTAL		291	0	0	291	1.5

1½-in. Copper and Brass Pipe

Springfield, Mass.	1941	2	0	0	2	1.5
Utica, N.Y.	1935	158	0	0	158	5.5
TOTAL		160	0	0	160	5.5

2-in. Copper and Brass Pipe

Springfield, Mass.	1940	578	0	0	578	2.5
Utica, N.Y.	1938	4	0	0	4	2.5
TOTAL		582	0	0	582	2.5

SUMMARY OF METERS—BY CITIES

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Des Moines, Iowa	1882	40,704	2,287	5.6	38,417	23.3
Ottawa, Ont.	1901	2,903	133	4.6	2,770	17.6
Portland, Me.	1885	11,248	924	8.2	10,324	17.8
St. Marys, Pa.	1905	1,991	297	14.9	1,694	12.3
St. Paul, Minn.	1898	68,486	7,796	11.4	60,690	19.0
Utica, N.Y.	1890	22,032	2,433	11.0	19,599	23.8
Winnipeg, Man.	1899	43,031	2,690	6.3	40,341	28.8
TOTAL		190,395	16,560	8.7	173,835	22.6

SUMMARY OF METERS—BY SIZES AND KINDS

Size, in.	Kind	Year of First Installation	Number Installed	Retired		In Service	
				Number	Percentage of Total Installed	Number	Average Age, yr.
$\frac{3}{8}$	Disc	1890	119,813	10,351	8.6	109,462	21.4
$\frac{1}{2}$		1891	5,796	488	8.4	5,308	12.8
1		1885	4,241	338	8.0	3,903	15.7
$1\frac{1}{2}$		1905	277	3	1.1	274	26.9
$1\frac{3}{4}$		1889	1,406	210	14.9	1,196	16.1
2		1889	1,160	164	14.1	996	21.2
3		1901	66	17	25.8	49	13.3
4		1912	6	5	83.3	1	21.5
6		1911	3	2	66.7	1	29.5
8		1911	3	1	33.3	2	28.5
12		1921	1	1	100.0	0	—
$\frac{3}{8}$	Rotary	1913	1	1	100.0	0	—
$\frac{1}{2}$		1930	7	0	0	7	10.5
$\frac{3}{4}$		1882	2,251	1,641	72.9	610	30.2
$\frac{1}{2}$		1883	191	58	30.4	133	18.0
1		1882	78	23	29.5	55	19.1
$1\frac{1}{2}$		1932	2	0	0	2	8.5
$1\frac{3}{4}$		1883	20	10	50.0	10	15.2
2		1883	56	39	69.6	17	23.7
3		1885	15	4	26.7	11	21.0
4		1889	3	2	66.7	1	25.5
6		1915	3	0	0	3	25.5
$\frac{3}{8}$	Piston	1897	4	1	25.0	3	8.5
$\frac{1}{2}$		1886	49,310	2,878	5.8	46,432	26.8
$\frac{3}{4}$		1886	2,173	45	2.1	2,128	31.7
1		1888	1,046	25	2.4	1,021	28.2
$1\frac{1}{2}$		1899	504	11	2.2	493	23.4
2		1888	579	43	7.4	536	21.2
3		1897	27	2	7.4	25	27.7
4		1896	14	3	21.4	11	16.8

SURVIVAL AND RETIREMENT

SUMMARY OF METERS—BY SIZES AND KINDS (contd.)

Size, in.	Kind	Year of First Instal- lation	Number Installed	Retired		In Service	
				Number	Percent- age of Total Installed	Number	Average Age, yr.
1½	Compound	1912	52	0	0	52	20.1
2		1911	187	0	0	187	16.5
3		1910	297	53	17.8	244	13.7
4		1909	223	43	19.3	180	14.5
6		1912	112	19	17.0	93	13.5
8	Current	1915	24	0	0	24	14.5
1½		1914	2	0	0	2	26.5
2		1889	87	36	41.4	51	23.2
3	Current and Other	1894	96	16	16.7	80	26.5
4		1890	96	18	18.8	78	25.6
6		1895	134	9	6.7	125	19.1
8		1917	29	0	0	29	20.5
TOTAL			190,395	16,560	8.7	173,835	22.6

SUMMARY OF METERS

¾-in. Disc Meters

City	Year of First Instal- lation	Number Installed	Retired		In Service	
			Number	Percent- age of Total Installed	Number	Average Age, yr.
Des Moines, Iowa	1890	37,493	466	1.2	37,027	23.2
Ottawa, Ont.	1901	935	42	4.5	893	14.1
Portland, Me.	1891	685	642	93.7	43	16.7
St. Marys, Pa.	1918	1,841	258	14.0	1,583	12.2
St. Paul, Minn.	1898	58,584	6,756	11.5	51,828	19.9
Utica, N.Y.	1890	18,219	1,055	5.8	17,164	23.3
Winnipeg, Man.	1900	2,056	1,132	55.1	924	17.4
TOTAL		119,813	10,351	8.6	109,462	21.4

¾-in. Disc Meters

Des Moines, Iowa	1904	302	4	1.3	298	16.2
Ottawa, Ont.	1901	401	9	2.2	392	12.2
Portland, Me.	1891	61	60	98.4	1	37.5
St. Marys, Pa.	1915	83	18	21.7	65	14.0
St. Paul, Minn.	1903	4,476	388	8.7	4,088	11.3
Utica, N.Y.	1903	422	0	0	422	26.6
Winnipeg, Man.	1901	51	9	17.6	42	1.5
TOTAL		5,796	488	8.4	5,308	12.8

1-in. Disc Meters

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Des Moines, Iowa	1900	422	11	2.6	411	25.5
Ottawa, Ont.	1901	285	16	5.6	269	16.7
Portland, Me.	1885	8	8	100.0	0	—
St. Marys, Pa.	1914	28	8	28.6	20	8.6
St. Paul, Minn.	1903	3,144	260	8.3	2,884	13.6
Utica, N.Y.	1899	237	0	0	237	23.5
Winnipeg, Man.	1902	117	35	29.9	82	15.5
TOTAL		4,241	338	8.0	3,903	15.7

1½-in. Disc Meters

Ottawa, Ont.	1919	14	1	7.1	13	17.8
St. Marys, Pa.	1905	7	1	14.3	6	27.8
St. Paul, Minn.	1912	256	1	0.4	255	27.3
TOTAL		277	3	1.1	274	26.9

1½-in. Disc Meters

Des Moines, Iowa	1900	152	15	9.9	137	21.1
Ottawa, Ont.	1908	113	1	0.9	112	11.9
Portland, Me.	1889	4	4	100.0	0	—
St. Marys, Pa.	1905	7	3	42.9	4	4.5
St. Paul, Minn.	1903	1,081	179	16.6	902	15.9
Utica, N.Y.	1906	19	0	0	19	24.1
Winnipeg, Man.	1911	30	8	26.7	22	8.7
TOTAL		1,406	210	14.9	1,196	16.1

2-in. Disc Meters

Des Moines, Iowa	1903	311	34	10.9	277	20.3
Portland, Me.	1889	14	13	92.9	1	28.5
Ottawa, Ont.	1901	214	2	0.9	212	20.8
St. Marys, Pa.	1920	9	5	55.6	4	6.5
St. Paul, Minn.	1903	500	75	15.0	425	22.1
Utica, N.Y.	1906	56	0	0	56	24.2
Winnipeg, Man.	1900	56	35	62.5	21	13.6
TOTAL		1,160	164	14.1	996	21.2

SURVIVAL AND RETIREMENT

3-in. Disc Meters

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Portland, Me.	1914	1	1	100.0	0	—
Ottawa, Ont.	1924	33	1	3.0	32	11.8
St. Marys, Pa.	1913	13	3	23.1	10	10.8
St. Paul, Minn.	1913	11	7	63.6	4	25.2
Winnipeg, Man.	1901	8	5	62.5	3	22.2
TOTAL		66	17	25.8	49	13.3

4-in. Disc Meters

Portland, Me.	1915	2	1	50.0	1	21.5
St. Paul, Minn.	1912	4	4	100.0	0	—
TOTAL		6	5	83.3	1	21.5

6-in. Disc Meters

Portland, Me.	1911	3	2	66.7	1	29.5
TOTAL		3	2	66.7	1	29.5

8-in. Disc Meters

Portland, Me.	1911	3	1	33.3	2	28.5
TOTAL		3	1	33.3	2	28.5

12-in. Disc Meters

Portland, Me.	1921	1	1	100.0	0	—
TOTAL		1	1	100.0	0	—

1-in. Rotary Meters

Ottawa, Ont.	1913	1	1	100.0	0	—
TOTAL		1	1	100.0	0	—

1-in. Rotary Meters

Ottawa, Ont.	1930	7	0	0	7	10.5
TOTAL		7	0	0	7	10.5

$\frac{1}{8}$ -in. Rotary Meters

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Des Moines, Iowa	1882	1,853	1,610	86.9	243	44.5
Ottawa, Ont.	1915	398	31	7.8	367	20.7
TOTAL		2,251	1,641	72.9	610	30.2

 $\frac{1}{4}$ -in. Rotary Meters

Des Moines, Iowa	1883	55	55	100.0	0	—
Ottawa, Ont.	1914	136	3	2.2	133	18.0
TOTAL		191	58	30.4	133	18.0

1-in. Rotary Meters

Des Moines, Iowa	1882	23	23	100.0	0	—
Ottawa, Ont.	1915	55	0	0	55	19.1
TOTAL		78	23	20.5	55	19.1

1 $\frac{1}{2}$ -in. Rotary Meters

Ottawa, Ont.	1932	2	0	0	2	8.5
TOTAL		2	0	0	2	8.5

1 $\frac{3}{4}$ -in. Rotary Meters

Des Moines, Iowa	1883	8	8	100.0	0	—
Ottawa, Ont.	1915	12	2	16.7	10	15.2
TOTAL		20	10	50.0	10	15.2

2-in. Rotary Meters

Des Moines, Iowa	1883	39	39	100.0	0	—
Ottawa, Ont.	1915	17	0	0	17	23.7
TOTAL		56	39	69.6	17	23.7

3-in. Rotary Meters

Des Moines, Iowa	1885	3	3	100.0	0	—
Ottawa, Ont.	1915	12	1	8.3	11	21.0
TOTAL		15	4	26.7	11	21.0

SURVIVAL AND RETIREMENT

4-in. Rotary Meters

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Des Moines, Iowa	1889	1	1	100.0	0	—
Ottawa, Ont.	1915	2	1	50.0	1	25.5
TOTAL		3	2	66.7	1	25.5

6-in. Rotary Meters

Ottawa, Ont.	1915	3	0	0	3	25.5
TOTAL		3	0	0	3	25.5

 $\frac{3}{4}$ -in. Piston Meters

Portland, Me.	1897	4	1	25.0	3	8.5
TOTAL		4	1	25.0	3	8.5

 $\frac{1}{2}$ -in. Piston Meters

Portland, Me.	1886	9,004	99	1.1	8,905	17.2
Utica, N.Y.	1890	2,660	1,378	51.8	1,282	30.2
Winnipeg, Man.	1899	37,646	1,401	3.7	36,245	29.0
TOTAL		49,310	2,878	5.8	46,432	26.8

 $\frac{1}{4}$ -in. Piston Meters

Portland, Me.	1886	511	18	3.5	493	24.8
Winnipeg, Man.	1899	1,662	27	1.6	1,635	33.8
TOTAL		2,173	45	2.1	2,128	31.7

1-in. Piston Meters

Portland, Me.	1888	303	12	4.0	291	21.6
Winnipeg, Man.	1899	743	13	1.7	730	30.9
TOTAL		1,046	25	2.4	1,021	28.2

1½-in. Piston Meters

Portland, Me.	1899	182	5	2.7	177	21.0
Winnipeg, Man.	1899	322	6	1.9	316	24.7
TOTAL		504	11	2.2	493	23.4

2-in. Piston Meters

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Portland, Me.	1888	365	32	8.8	333	18.5
Winnipeg, Man.	1899	214	11	5.1	203	25.5
TOTAL		579	43	7.4	536	21.2

3-in. Piston Meters

Portland, Me.	1901	13	1	7.7	12	20.6
Utica, N.Y.	1897	2	0	0	2	42.0
Winnipeg, Man.	1901	12	1	8.3	11	32.9
TOTAL		27	2	7.4	25	27.7

4-in. Piston Meters

Portland, Me.	1896	12	3	25.0	9	13.6
Winnipeg, Man.	1912	2	0	0	2	30.5
TOTAL		14	3	21.4	11	16.8

1½-in. Compound Meters

Ottawa, Ont.	1919	1	0	0	1	21.5
Utica, N.Y.	1912	51	0	0	51	20.1
TOTAL		52	0	0	52	20.1

2-in. Compound Meters

Ottawa, Ont.	1919	25	0	0	25	19.7
St. Paul, Minn.	1931	50	0	0	50	4.8
Utica, N.Y.	1911	112	0	0	112	21.0
TOTAL		187	0	0	187	16.5

3-in. Compound Meters

Des Moines, Iowa	1914	2	0	0	2	25.5
Ottawa, Ont.	1919	31	0	0	31	19.0
Portland, Me.	1925	1	0	0	1	15.5
St. Paul, Minn.	1916	173	53	30.6	120	8.1
Utica, N.Y.	1910	35	0	0	35	22.0
Winnipeg, Man.	1913	55	0	0	55	17.0
TOTAL		297	53	17.8	244	13.7

4-in. Compound Meters

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Des Moines, Iowa	1909	3	0	0	3	22.2
Ottawa, Ont.	1915	22	0	0	22	18.4
Portland, Me.	1913	9	0	0	9	17.1
St. Paul, Minn.	1915	118	43	36.4	75	8.0
Utica, N.Y.	1910	48	0	0	48	20.9
Winnipeg, Man.	1913	23	0	0	23	16.2
TOTAL		223	43	19.3	180	14.5

6-in. Compound Meters

Des Moines, Iowa	1922	6	1	16.7	5	2.9
Ottawa, Ont.	1915	24	0	0	24	17.7
Portland, Me.	1930	6	0	0	6	5.5
St. Paul, Minn.	1912	44	18	40.9	26	10.8
Utica, N.Y.	1916	28	0	0	28	15.6
Winnipeg, Man.	1920	4	0	0	4	15.8
TOTAL		112	19	17.0	93	13.5

8-in. Compound Meters

Ottawa, Ont.	1915	10	0	0	10	16.2
Portland, Me.	1921	4	0	0	4	14.8
St. Paul, Minn.	1935	2	0	0	2	5.5
Utica, N.Y.	1917	8	0	0	8	14.4
TOTAL		24	0	0	24	14.5

1½-in. Current Meters

Ottawa, Ont.	1914	2	0	0	2	26.5
TOTAL		2	0	0	2	26.5

2-in. Current Meters

Ottawa, Ont.	1907	52	16	30.8	36	21.7
Portland, Me.	1889	31	16	51.6	15	26.9
Winnipeg, Man.	1905	4	4	100.0	0	—
TOTAL		87	36	41.4	51	23.2

3-in. Current and Other Meters

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percent-age of Total Installed	Number	Average Age, yr.
Des Moines, Iowa	1906	11	3	27.3	8	27.1
Ottawa, Ont.	1905	37	4	10.8	33	24.8
Portland, Me.	1894	3	0	0	3	45.8
St. Paul, Minn.	1914	19	7	36.8	12	12.7
Utica, N.Y.	1904	8	0	0	8	34.9
Winnipeg, Man.	1903	18	2	11.1	16	32.1
TOTAL		96	16	16.7	80	26.5

4-in. Current and Other Meters

Des Moines, Iowa	1890	11	8	72.7	3	36.5
Ottawa, Ont.	1904	35	2	5.7	33	23.7
Portland, Me.	1894	11	3	27.3	8	39.3
St. Marys, Pa.	1914	2	1	50.0	1	9.5
St. Paul, Minn.	1916	10	3	30.0	7	19.5
Utica, N.Y.	1897	20	0	0	20	24.2
Winnipeg, Man.	1906	7	1	14.3	6	26.8
TOTAL		96	18	18.8	78	25.6

6-in. Current and Other Meters

Des Moines, Iowa	1906	9	6	66.7	3	31.5
Ottawa, Ont.	1906	20	0	0	20	22.5
Portland, Me.	1895	7	1	14.3	6	36.0
St. Marys, Pa.	1914	1	0	0	1	23.5
St. Paul, Minn.	1912	13	2	15.4	11	17.3
Utica, N.Y.	1906	83	0	0	83	16.8
Winnipeg, Man.	1926	1	0	0	1	16.5
TOTAL		134	9	6.7	125	19.1

8-in. Current and Other Meters

Ottawa, Ont.	1919	4	0	0	4	21.0
St. Paul, Minn.	1917	1	0	0	1	24.5
Utica, N.Y.	1919	24	0	0	24	20.3
TOTAL		29	0	0	29	20.5

SUMMARY OF VALVES—BY CITIES

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Alexandria, Va.	1852	484	3	0.6	481	25.5
Babylon, N.Y.	1893	321	3	0.9	318	23.6
Clyde, N.Y.	1889	31	0	0	31	43.6
Denver, Colo.	1872	12,398	1,577	12.7	10,821	28.7
Des Moines, Iowa	1881	2,588	10	0.4	2,578	24.5
Merrick, N.Y.	1912	521	3	0.6	518	12.0
Norwich, N.Y.	1831	277	7	2.5	270	39.6
Rochester (Suburban), N.Y.	1905	830	8	1.0	822	22.9
Sag Harbor, N.Y.	1889	67	2	3.0	65	42.2
Summit, N.J.	1889	3,756	84	2.2	3,672	14.2
Syracuse (Suburban), N.Y.	1910	431	14	3.2	417	18.4
TOTAL		21,704	1,711	7.9	19,993	24.7

SUMMARY OF VALVES—BY SIZES

Size, in.	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
1	1895	34	11	32.4	23	24.8
1½	1890	34	16	47.1	18	24.3
1½	1892	60	23	38.3	37	24.6
2	1890	1,154	518	44.9	636	17.4
2½	1907	4	1	25.0	3	13.2
3	1881	788	161	20.4	627	10.5
4	1852	2,514	351	14.0	2,163	29.4
6	1852	9,991	407	4.1	9,584	25.2
8	1852	3,644	64	1.8	3,580	23.4
10	1852	387	25	6.5	362	34.1
12	1881	2,206	89	4.0	2,117	23.8
14	1890	90	10	11.1	80	38.0
15	1872	8	0	0	8	57.3
16	1883	255	17	6.7	238	27.7
18	1890	44	1	2.3	43	37.0
20	1881	204	7	3.4	197	23.4
24	1890	186	7	3.8	179	22.2
30	1888	71	2	2.8	69	15.2
36	1924	22	0	0	22	13.4
42	1924	4	1	25.0	3	5.8
48	1925	4	0	0	4	11.5
TOTAL		21,704	1,711	7.9	19,993	24.7

SUMMARY OF VALVES

1-in. Valves

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Alexandria, Va.	1926	4	0	0	4	4.5
Denver, Colo.	1895	30	11	36.7	19	29.1
TOTAL		34	11	32.4	23	24.8

1½-in. Valves

Denver, Colo.	1890	34	16	47.1	18	24.3
TOTAL		34	16	47.1	18	24.3

1½-in. Valves

Denver, Colo.	1892	60	23	38.3	37	24.6
TOTAL		60	23	38.3	37	24.6

2-in. Valves

Alexandria, Va.	1912	25	0	0	25	5.5
Denver, Colo.	1890	1,129	518	45.9	611	17.9
TOTAL		1,154	518	44.9	636	17.4

2½-in. Valves

Alexandria, Va.	1926	1	0	0	1	4.5
Denver, Colo.	1907	3	1	33.3	2	17.5
TOTAL		4	1	25.0	3	13.2

3-in. Valves

Alexandria, Va.	1925	5	0	0	5	27.5
Denver, Colo.	1881	783	161	20.6	622	10.4
TOTAL		788	161	20.4	627	10.5

4-in. Valves

Alexandria, Va.	1852	156	2	1.3	154	35.4
Babylon, N.Y.	1893	84	1	1.2	83	28.4
Clyde, N.Y.	1889	6	0	0	6	22.8

4-in Valves (contd.)

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Denver, Colo.	1881	943	277	29.4	666	37.5
Des Moines, Iowa	1884	13	0	0	13	26.3
Merrick, N.Y.	1912	82	1	1.2	81	18.8
Norwich, N.Y.	1881	122	5	4.1	117	42.1
Rochester (Suburban), N.Y.	1905	13	0	0	13	25.8
Sag Harbor, N.Y.	1889	46	0	0	46	41.3
Summit, N.J.	1889	1,042	65	6.2	977	22.0
Syracuse (Suburban), N.Y.	1910	7	0	0	7	24.9
TOTAL		2,514	351	14.0	2,163	29.4

6-in. Valves

Alexandria, Va.	1852	182	1	0.5	181	22.4
Babylon, N.Y.	1893	194	1	0.5	193	21.3
Clyde, N.Y.	1889	15	0	0	15	48.4
Denver, Colo.	1880	5,475	379	6.9	5,096	33.1
Des Moines, Iowa	1881	501	0	0	501	29.3
Merrick, N.Y.	1912	295	2	0.7	293	10.7
Norwich, N.Y.	1881	101	0	0	101	38.1
Rochester (Suburban), N.Y.	1905	513	2	0.4	511	22.6
Sag Harbor, N.Y.	1889	10	0	0	10	41.8
Summit, N.J.	1889	2,461	16	0.7	2,445	10.7
Syracuse (Suburban), N.Y.	1910	244	6	2.5	238	17.2
TOTAL		9,991	407	4.1	9,584	25.2

8-in. Valves

Alexandria, Va.	1852	49	0	0	49	24.8
Babylon, N.Y.	1893	29	1	3.4	28	30.4
Clyde, N.Y.	1889	8	0	0	8	48.1
Denver, Colo.	1883	1,311	47	3.6	1,264	23.7
Des Moines, Iowa	1884	1,791	4	0.2	1,787	23.4
Merrick, N.Y.	1922	74	0	0	74	10.4
Norwich, N.Y.	1881	16	0	0	16	47.9
Rochester (Suburban), N.Y.	1905	168	4	2.4	164	25.0
Sag Harbor, N.Y.	1889	9	2	22.2	7	46.5
Summit, N.J.	1889	132	2	1.5	130	19.1
Syracuse (Suburban), N.Y.	1910	57	4	7.0	53	20.5
TOTAL		3,644	64	1.8	3,580	23.4

10-in. Valves

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Alexandria, Va.	1852	36	0	0	36	18.0
Babylon, N.Y.	1926	10	0	0	10	14.0
Clyde, N.Y.	1889	2	0	0	2	51.5
Denver, Colo.	1890	263	24	9.1	239	39.0
Des Moines, Iowa	1896	3	0	0	3	46.5
Merrick, N.Y.	1937	1	0	0	1	3.5
Norwich, N.Y.	1881	11	0	0	11	43.4
Rochester (Suburban), N.Y.	1908	5	0	0	5	32.5
Sag Harbor, N.Y.	1889	2	0	0	2	51.5
Summit, N.J.	1889	53	1	1.9	52	23.2
Syracuse (Suburban), N.Y.	1910	1	0	0	1	30.5
TOTAL		387	25	6.5	362	34.1

12-in. Valves

Alexandria, Va.	1885	18	0	0	18	20.8
Babylon, N.Y.	1926	4	0	0	4	11.5
Denver, Colo.	1883	1,820	86	4.7	1,734	24.6
Des Moines, Iowa	1888	164	2	1.2	162	25.4
Merrick, N.Y.	1926	69	0	0	69	11.6
Norwich, N.Y.	1881	23	1	4.3	22	25.7
Rochester (Suburban), N.Y.	1905	42	0	0	42	19.0
Summit, N.J.	1899	28	0	0	28	10.9
Syracuse (Suburban), N.Y.	1910	38	0	0	38	17.1
TOTAL		2,206	89	4.0	2,117	23.8

14-in. Valves

Denver, Colo.	1890	74	9	12.2	65	45.9
Des Moines, Iowa	1941	14	0	0	14	1.5
Norwich, N.Y.	1902	2	1	50.0	1	38.5
TOTAL		90	10	11.1	80	38.0

15-in. Valves

Denver, Colo.	1872	8	0	0	8	57.3
TOTAL		8	0	0	8	57.3

16-in. Valves

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percent-age of Total Installed	Number	Average Age, yr
Alexandria, Va.	1885	5	0	0	5	40.7
Denver, Colo.	1890	150	10	6.7	140	33.0
Des Moines, Iowa	1883	34	3	8.8	31	29.9
Norwich, N.Y.	1902	2	0	0	2	33.0
Rochester (Suburban), N.Y.	1931	4	0	0	4	7.3
Summit, N.J.	1912	28	0	0	28	8.9
Syracuse (Suburban), N.Y.	1910	32	4	12.5	28	17.7
TOTAL		255	17	6.7	238	27.7

18-in. Valves

Denver, Colo.	1890	42	1	2.4	41	37.8
Summit, N.J.	1912	2	0	0	2	21.5
TOTAL		44	1	2.3	43	37.0

20-in. Valves

Alexandria, Va.	1885	3	0	0	3	38.5
Denver, Colo.	1881	48	5	10.4	43	24.5
Des Moines, Iowa	1883	35	0	0	35	20.4
Rochester (Suburban), N.Y.	1905	84	2	2.4	82	22.2
Summit, N.J.	1912	3	0	0	3	10.8
Syracuse (Suburban, N.Y.)	1910	31	0	0	31	28.5
TOTAL		204	7	3.4	197	23.4

24-in. Valves

Denver, Colo.	1890	150	7	4.7	143	24.3
Des Moines, Iowa	1922	7	0	0	7	19.1
Rochester (Suburban), N.Y.	1930	1	0	0	1	10.5
Summit, N.J.	1917	7	0	0	7	10.2
Syracuse (Suburban), N.Y.	1910	21	0	0	21	13.2
TOTAL		186	7	3.8	179	22.2

30-in. Valves

Denver, Colo.	1888	45	1	2.2	44	16.9
Des Moines, Iowa	1921	26	1	3.8	25	12.1
TOTAL		71	2	2.8	69	15.2

36-in. Valves

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Denver, Colo.	1924	22	0	0	22	13.4
TOTAL		22	0	0	22	13.4

42-in. Valves

Denver, Colo.	1924	4	1	25.0	3	5.8
TOTAL		4	1	25.0	3	5.8

48-in. Valves

Denver, Colo.	1925	4	0	0	4	11.5
TOTAL		4	0	0	4	11.5

SUMMARY OF SERVICES—BY CITIES*

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Clyde, N.Y.	1894	827	190	23.0	637	23.8
Denver, Colo.†	1875	75,729	3,876	5.1	71,853	29.2
West Palm Beach, Fla.	1927	47,882	390	4.4	8,397	8.5
Winnipeg, Man.	1882	8,787	7,141	14.9	40,741	26.3
TOTAL		133,225	11,597	8.7	121,628	26.8

* Winnipeg and West Palm Beach services reported by feet. For summary purposes converted to number. Winnipeg 27.8 ft. per average service and West Palm Beach 18.28 ft. per average service.

† Lead only.

SUMMARY OF SERVICES—BY SIZES AND KINDS*

Size, in.	Kind	Number Installed	Retired		In Service	
			Number	Percent- age of Total Installed	Number	Average Age, yr.
$\frac{1}{8}$	Lead	28,709	4,556	15.9	24,158	33.3
$\frac{3}{8}$		43,129	3,159	7.3	39,970	35.9
$\frac{1}{2}$		37,696	1,788	4.7	35,908	19.9
1		4,000	342	8.6	3,658	30.4
$1\frac{1}{8}$		312	12	3.8	300	22.5
$1\frac{1}{2}$		484	29	6.0	455	35.7
2		159	13	8.2	146	33.9
3		26	4	15.4	22	16.0
SUBTOTAL		114,515	9,903	8.6	104,612	29.6
$\frac{1}{8}$	Wrought-iron and Steel	206	199	96.6	7	49.5
$\frac{3}{8}$		5	5	100.0	0	—
$\frac{1}{2}$		1,493	947	63.4	546	22.6
1		1,748	235	13.4	1,513	9.5
$1\frac{1}{8}$		1,532	39	2.5	1,493	12.9
$1\frac{1}{2}$		1,013	25	2.5	988	12.1
2		547	71	13.0	476	10.6
$2\frac{1}{2}$		2	2	100.0	0	—
3		8	6	75.0	2	18.8
SUBTOTAL		6,554	1,529	23.3	5,025	12.6
$\frac{1}{8}$	Copper	2,790	23	0.8	2,767	12.3
$\frac{3}{8}$		635	5	0.8	630	12.0
$\frac{1}{2}$		5,521	61	1.1	5,460	4.7
1		1,785	33	1.8	1,752	5.8
$1\frac{1}{8}$		98	1	1.0	97	4.4
$1\frac{1}{2}$		253	12	4.7	241	4.9
2		331	5	1.5	326	6.2
SUBTOTAL		11,413	140	1.2	11,273	7.2
3	Cast-iron	17	7	41.2	10	42.4
4		436	16	3.7	420	28.1
6		263	2	0.8	261	19.7
8		27	0	0.0	27	16.9
SUBTOTAL		743	25	3.4	718	24.8
TOTAL		133,225	11,597	8.7	121,628	26.8

* Winnipeg and West Palm Beach services reported by feet. For summary purposes converted to number. Winnipeg 27.8 ft. per average service and West Palm Beach 18.28 ft. per average service.

SUMMARY OF SERVICES

½-in. Lead Services

City	Year of First Installation	No. of Feet Installed	Retired		In Service	
			No. of Feet	Percentage of Total Installed	No. of Feet	Average Age, yr.
Denver, Colo.	1875	5,121	921	18.0	4,200	49.7
Winnipeg, Man.	1894	23,588	3,635	15.4	19,953	29.8
TOTAL		28,709	4,556	15.9	24,153	33.3

⅝-in. Lead Services

Clyde, N.Y.	1921	119	1	0.8	118	19.4
Denver, Colo.	1875	33,661	1,739	5.2	31,922	36.7
Winnipeg, Man.	1895	9,349	1,419	15.2	7,930	32.8
TOTAL		43,129	3,159	7.3	39,970	35.9

¾-in. Lead Services

Denver, Colo.	1875	33,821	1,027	3.0	32,794	19.1
Winnipeg, Man.	1894	3,875	761	19.6	3,114	28.7
TOTAL		37,696	1,788	4.7	35,908	19.9

1-in. Lead Services

Denver, Colo.	1875	2,164	135	6.2	2,029	32.0
Winnipeg, Man.	1897	1,836	207	11.3	1,629	28.5
TOTAL		4,000	342	8.6	3,658	30.4

1½-in. Lead Services

Denver, Colo.	1887	312	12	3.8	300	22.5
TOTAL		312	12	3.8	300	22.5

1½-in. Lead Services

Denver, Colo.	1888	480	28	5.8	452	35.7
Winnipeg, Man.	1899	4	1	25.0	3	32.5
TOTAL		484	29	6.0	455	35.7

SURVIVAL AND RETIREMENT

2-in. Lead Services

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Denver, Colo.	1881	144	10	6.9	134	34.7
Winnipeg, Man.	1895	15	3	20.0	12	24.6
TOTAL		159	13	8.2	146	33.9

3-in. Lead Services

Denver, Colo	1900	26	4	15.4	22	16.0
TOTAL		26	4	15.4	22	16.0

 $\frac{1}{2}$ -in. Wrought-Iron and Steel Services

Clyde, N.Y.	1890	13	6	46.2	7	49.5
Winnipeg, Man.	1882	193	193	100.0	0	—
TOTAL		206	199	96.6	7	49.5

 $\frac{1}{4}$ -in. Wrought-Iron and Steel Services

Winnipeg, Man.	1882	5	5	100.0	0	—
TOTAL		5	5	100.0	0	—

 $\frac{3}{4}$ -in. Wrought-Iron and Steel Services

Clyde, N.Y.	1889	580	179	30.9	401	28.8
West Palm Beach, Fla.	1929	243	98	40.3	145	5.5
Winnipeg, Man.	1882	670	670	100.0	0	—
TOTAL		1,493	947	63.4	546	22.6

1-in. Wrought-Iron and Steel Services

Clyde, N.Y.	1897	10	1	10.0	9	21.2
West Palm Beach, Fla.	1927	1,618	114	7.0	1,504	9.4
Winnipeg, Man.	1882	120	120	100.0	0	—
TOTAL		1,748	235	13.4	1,513	9.5

1½-in. Wrought-Iron and Steel Services

Clyde, N.Y.	1890	4	2	50.0	2	13.0
West Palm Beach, Fla.	1927	1,522	31	2.0	1,491	12.9
Winnipeg, Man.	1895	6	6	100.0	0	—
TOTAL		1,532	39	2.5	1,493	12.9

1½-in. Wrought-Iron and Steel Services

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Clyde, N.Y.	1894	3	0	0	3	27.2
West Palm Beach, Fla.	1927	997	12	1.2	985	12.1
Winnipeg, Man.	1882	13	13	100.0	0	—
TOTAL		1,013	25	2.5	988	12.1

2-in. Wrought-Iron and Steel Services

Clyde, N.Y.	1890	2	1	50.0	1	29.5
West Palm Beach, Fla.	1927	523	48	9.2	475	10.6
Winnipeg, Man.	1884	22	22	100.0	0	—
TOTAL		547	71	13.0	476	10.6

2½-in. Wrought-Iron and Steel Services

Winnipeg, Man.	1885	2	2	100.0	0	—
TOTAL		2	2	100.0	0	—

3-in. Wrought-Iron and Steel Services

Clyde, N.Y.	1914	1	0	0	1	26.5
West Palm Beach, Fla.	1929	1	0	0	1	11.2
Winnipeg, Man.	1885	6	6	100.0	0	—
TOTAL		8	6	75.0	2	18.8

½-in. Copper Services

Winnipeg, Man.	1925	2,790	23	0.8	2,767	12.3
TOTAL		2,790	23	0.8	2,767	12.3

¾-in. Copper Services

Winnipeg, Man.	1927	635	5	0.8	630	12.0
TOTAL		635	5	0.8	630	12.0

1-in. Copper Services

Clyde, N.Y.	1928	92	0	0	92	6.3
West Palm Beach, Fla.	1928	2,051	46	2.2	2,005	4.4
Winnipeg, Man.	1927	3,378	15	0.4	3,363	4.8
TOTAL		5,521	61	1.1	5,460	4.7

SURVIVAL AND RETIREMENT

1-in. Copper Services

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
West Palm Beach, Fla.	1928	1,251	22	1.8	1,229	4.9
Winnipeg, Man.	1927	534	11	2.1	523	8.0
TOTAL		1,785	33	1.8	1,752	5.8

1½-in. Copper Services

West Palm Beach, Fla.	1930	86	1	1.2	85	4.7
Winnipeg, Man.	1938	12	0	0	12	2.5
TOTAL		98	1	1.0	97	4.4

1½-in. Copper Services

West Palm Beach, Fla.	1928	232	12	5.2	220	4.9
Winnipeg, Man.	1935	21	0	0	21	5.0
TOTAL		253	12	4.7	241	4.9

2-in. Copper Services

West Palm Beach, Fla.	1930	248	5	2.0	243	4.8
Winnipeg, Man.	1927	83	0	0	83	10.2
TOTAL		331	5	1.5	326	6.2

3-in. Cast-Iron Services

Winnipeg, Man.	1884	17	7	41.2	10	42.4
TOTAL		17	7	41.2	10	42.4

4-in. Cast-Iron Services

Clyde, N.Y.	1929	1	0	0	1	11.5
West Palm Beach, Fla.	1930	15	1	6.7	14	6.7
Winnipeg, Man.	1887	420	15	3.6	405	28.9
TOTAL		436	16	3.7	420	28.1

6-in. Cast-Iron Services

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Clyde, N.Y.	1920	2	0	0	2	16.5
Winnipeg, Man.	1898	261	2	0.8	259	19.7
TOTAL		263	2	0.8	261	19.7

8-in. Cast-Iron Services

Winnipeg, Man.	1913	27	0	0	27	16.9
TOTAL		27	0	0	27	16.9

SUMMARY OF HYDRANTS—BY CITIES

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
Babylon, N.Y.	1893	385	100	26.0	285	15.1
Clyde, N.Y.	1889	90	0	0	90	38.9
Denver, Colo.	1885	4,910	375	7.6	4,535	35.4
Des Moines, Iowa	1881	3,733	279	7.5	3,454	24.3
Merrick, N.Y.	1912	616	40	6.5	576	11.5
Norwich, N.Y.	1881	167	53	31.7	114	19.0
Rochester (Suburban), N.Y.	1905	786	45	5.7	741	18.2
St. Marys, Pa.	1889	91	18	19.8	73	27.6
Syracuse (Suburban), N.Y.	1910	253	10	4.0	243	11.3
Utica, N.Y.	1849	1,726	150	8.7	1,576	28.5
TOTAL		12,757	1,070	8.4	11,687	27.7

SUMMARY OF HYDRANTS—BY SIZES

Size, in.	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percentage of Total Installed	Number	Average Age, yr.
4	1849	4,035	626	15.5	3,409	26.2
5	1881	8,722	444	5.1	8,278	28.4
TOTAL		12,757	1,070	8.4	11,687	27.7

SUMMARY OF HYDRANTS

4-in. Hydrants

City	Year of First Installation	Number Installed	Retired		In Service	
			Number	Percent- age of Total Installed	Number	Average Age, yr.
Babylon, N.Y.	1893	353	99	28.0	254	15.6
Clyde, N.Y.	1889	90	0	0	90	38.9
Denver, Colo.	1885	612	243	39.7	369	41.5
Merrick, N.Y.	1912	388	36	9.3	352	14.4
Norwich, N.Y.*	1881	167	53	31.7	114	19.0
Rochester (Suburban), N.Y.	1905	574	21	3.7	553	21.2
St. Marys, Pa.	1889	91	18	19.8	73	27.6
Syracuse (Suburban), N.Y.	1910	34	6	17.6	28	23.9
Utica, N.Y.†	1849	1,726	150	8.7	1,576	28.5
TOTAL		4,035	626	15.5	3,409	26.2

5-in. Hydrants

Babylon, N.Y.	1926	32	1	3.1	31	9.7
Denver, Colo.	1889	4,298	132	3.1	4,166	34.9
Des Moines, Iowa‡	1881	3,733	279	7.5	3,454	24.3
Merrick, N.Y.	1931	228	4	1.8	224	6.9
Rochester (Suburban), N.Y.	1915	212	24	11.3	188	9.3
Syracuse (Suburban), N.Y.	1927	219	4	1.8	215	9.6
TOTAL		8,722	444	5.1	8,278	28.4

* Includes 5-in.

† Includes all sizes.

‡ Includes 4- and 6-in.

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